RAINFALL.

TO THE EDITOR OF THE SHREWSBURY CHRONICLE.

SIR,—The following is a monthly record of the rainfall at four stations in the valley which supplies the water of the river Onny. These stations are Woolstaston, Cardington, More, and Stokesay. The special object of these observations has been to compare the amount of deposit or sediment carried down by the stream with that of the rain, with a view to determining the rate at which the surface of the whole valley, measuring 84 square miles, is annually denuded. I am very sorry to say that during the last year this experiment, which had been carried on during the two previous years, has been interrupted, owing to the stream having been diverted from its course, to irrigate the meadows of the Onny valley, but it is hoped that, during the coming year, means may be found to resume it.

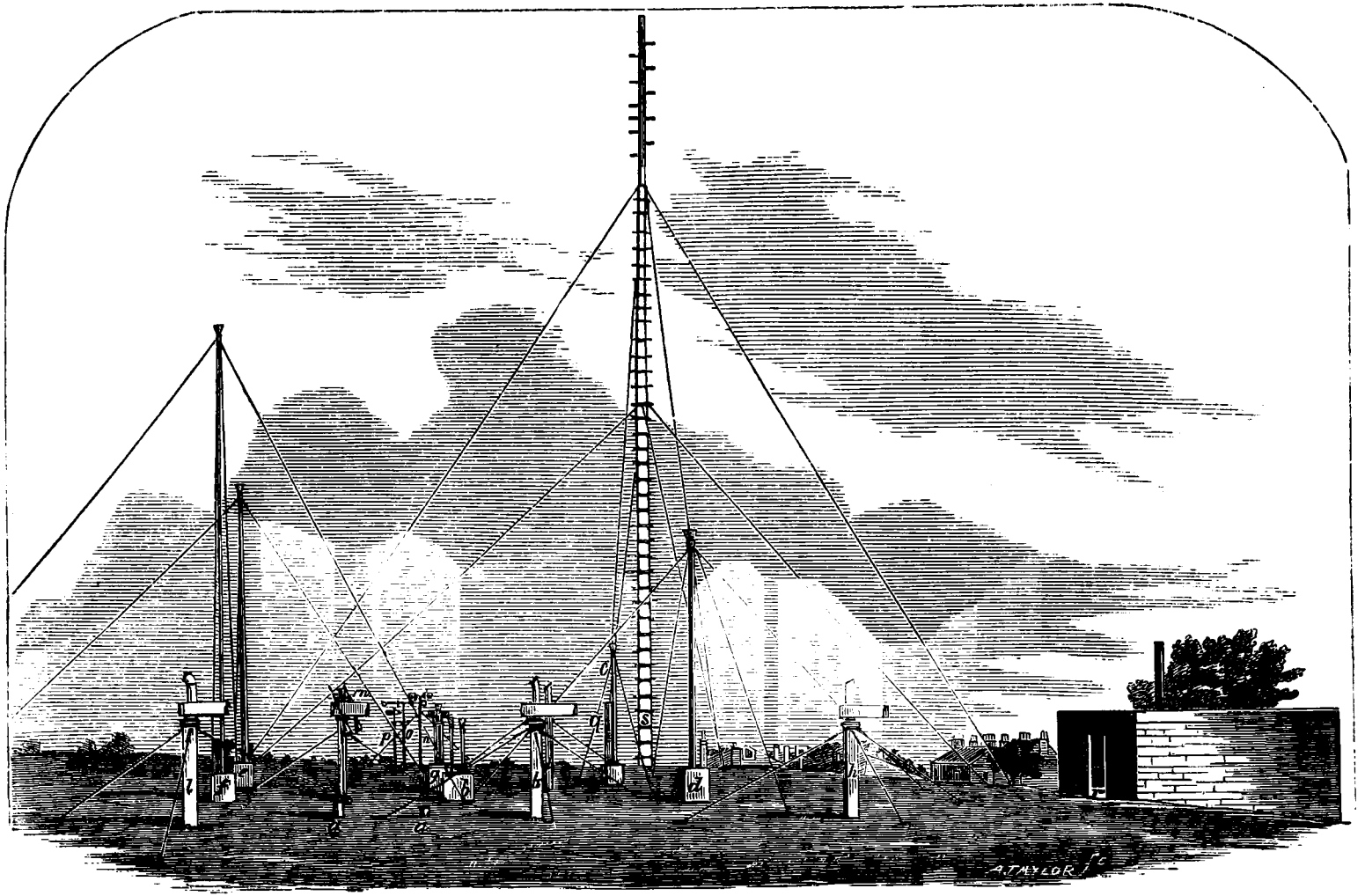
I am anxious to call attention to this experiment, since it might be possible to make similar observations on a larger river, such as the Severn, which would not be liable to interruption, such as a small stream, like the Onny, is subject to.

An excellent gauge has been erected on the banks of the Severn, opposite the Quarry, at Shrewsbury, and it would be only necessary to collect specimens of water, at intervals, during floods, and to note the heights of the water on this gauge, to obtain all the requisite data.

Should any of your readers be disposed to aid in this interesting experiment, I should be extremely glad to communicate with them and give them further information. I shall only now add that the geological section of the British Association has thought the inquiry of sufficient importance to make grants during the last two years to defray any necessary expenses.—I am, Sir, yours faithfully,

J. D. LA TOUCHE.

1870.	Stokesay. Inches.	More. Inches.	Woolstaston. Inches.	Cardington. Inches.
July	1·68	0·86	0·98	1·12
August	1·73	1·82	1·92	2·26
September	1·02	1·10	1·22	1·01
October	5·07	5·14	6·29	6·21
November	3·26	3 33	3·42	2·78
December	2·24	2·22	2·55	2·31
1871.				
January	3·38	3·16	2·77	2·92
February	1·80	1·38	1·66	1·50
March	1·66	1·45	1·42	1·06
April	2·55	2.27	3·22	2·60
May	0·87	0·98	1·20	1·06
June	2·97	2·72	3·61	3·61
Total	28·23	26·43	30·26	28·44



EXPERIMENTAL RAIN GAUGES, BOSTON RESERVOIR, ROTHERHAM, YORKS. [See page 11

BRITISH RAINFALL, 1869.

ON

THE DISTRIBUTION OF RAIN

OVER THE

BRITISH ISLES,

DURING THE YEAR

1869,

AS OBSERVED AT ABOUT 1500 STATIONS IN GREAT BRITAIN AND IRELAND,

WITH REMARKS ON VARIOUS EXPERIMENTS,
AND AN APPENDIX ON EVAPORATION.

COMPILED BY

G. J. SYMONS, F.M.S.,

(Member of the Scottish Meteorological Society.)

LONDON:
EDWARD STANFORD, CHARING CROSS, S.W.
SIMPKIN, MARSHALL & Co., STATIONER'S HALL COURT.
1870.

NOTE.

The Author being very anxious to make these Tables as complete as possible, will be obliged by information of, or from, any persons who record the fall of rain in the British Isles, but who have not hitherto communicated their observations to him. He also desires to be informed of any registers of the fall in previous years, however remote the place or period of observation, or however long discontinued.

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ERRATA IN BRITISH RAINFALL, 1868.

Page 46.—Line 15 from bottom.—*for* "plus," *read* "minus."
, 46.— „ 14 „ „ —*for* "66·05," *read* "62·25.
„ 113.— „ 16 „ top —*for* "Carelton," *read* "Carleton."
„ 121.— „ 25 „ bottom—*for* "Watkins," *read* "Watson."
122.—Lines 3 & 4 from top—the amounts 39·69 and 44·80 are transposed.
„ 133.—Lochgilphead—*for* "75·20," *read* "76·20."

BRITISH RAINFALL, 1869.

THE present work completes the first decade of systematic rainfall publications, and I cannot refrain from devoting this most prominent portion of it to recording my thanks to the hundreds, I might almost say thousands, of observers who have enabled me to make it what it is; for their uniform courtesy in replying to all kinds of queries, and for the great and increasing care which they devote to the subject. It is not for me to compare the present record with the puny little leaflet of 1860, but I may perhaps be permitted to call attention to the table of errata for 1868, as proof that efforts after even still greater accuracy on the part of the observers will not be vitiated by careless editing. We are now in rainfall matters far ahead of every nation in the world, but that is no reason for resting content with things as they are, when, by continued care, they can be made better.

G. J. SYMONS.

62, *Camden Square, N.W.*
March 10, 1870.

REPORT.

In addition to the steady maintenance of the routine work of complete registration of the records, of which some of the results are annually published in these pages, even more than ordinary pains have been taken during the past year (1) to raise the efficiency of the observers to the highest point, and (2) to secure an improved geographical distribution of stations.

Among the means adopted to secure the first object may be mentioned wide circulation of the Rules for Observers, first printed in *British Rainfall*, 1868, immediate notification to those whose returns indicate that they do not conform thereto—a proceeding which I extremely regret and dislike, but which is indispensable; personal examination of a large number of stations; watchfulness over instruments supplied.

Examination of Rain Gauges.—During the year 1869 I examined 115 gauges, thus distributed over the country:—

Berkshire	4	Hampshire	3
Cheshire	4	Lancashire	1
Cornwall	41	Middlesex	6
Derbyshire	1	Scilly Isles	2
Devonshire	32	Yorkshire	21

This brings the total number of gauges actually visited and tested up to 397*, which, however, is not one quarter of the number actually at work, every one of which *ought* to be visited not only once, but say every five years; at the same time, the benefit conferred by even this partial examination in removing errors, and stirring up observers to increased care, is very great.

* I may remark *en passant* that this implies an amount of travelling far exceeding the semi-diameter of the globe.

Improved Geographical Distribution of Stations.—The special steps taken with this object during 1869 are best illustrated by a few quotations.

EXTRACT FROM REPORT OF THE RAINFALL COMMITTEE FOR 1868-69.

"It has been the practice of the Committee, in their various reports, to adopt for convenience of comparison, a decennial grouping of returns, such as 1840-49, 1850-59, &c. We are now on the eve of completing one of these decennial periods, and it behoves us, therefore, to consider how we may best secure for the ensuing period the attainment of the objects for which we were originally appointed. One of these is expressed in the first grant in the following words: 'For the purpose of constructing and transmitting rain gauges to districts where observations are not at present made.'

"Even to those least acquainted with the subject, it will be apparent how much more desirable, as well as easy, it is to compare simultaneous observations than those wherein both the observed values, and their times are different. Your Committee, have, therefore, felt it to be their duty to examine how far the existing stations adequately represent the true rainfall of the British Isles. The result shows that their number and distribution, though incomparably superior to that which existed when your Committee were appointed some years since, is still capable of great improvement; tracts of land, the rainfall of which as water supply for towns is of high importance, are without adequate observations, while other places are, if possible, too well provided.

"To take Devonshire as an example: excepting two gauges at the Convict Prison, one on the northern edge of Chagford, and one on the south at Lee Moor Clay Works, Dartmoor (that wettest of Devonshire districts) has no representative, Exmoor has none at all, and there is no gauge between Torquay and Plymouth. On the other hand, Sidmouth has four or five observers, and Exeter an equal number.

"Similar cases of unequal representation occur in various parts, and should be removed. The Tyneside Naturalists' Club are about to establish a series of gauges along the Cheviots, the Cardiff Naturalists' Society are doing the same in South Wales, and other instances could be quoted.

"We have already shown that there is a special reason for endeavouring to equalize the representation during the ensuing autumn, so that the new observers whom we hope to obtain may have a few months' practice before the commencement of the decennial period of 1870-79.

"We hope that the landed proprietors of Great Britain and Ireland are becoming sufficiently aware of the importance of rainfall statistics in engineering and draining operations to see their own advantage in helping us by having observations regularly made by careful persons under their own supervision."

During the autumn of 1869 I spent some time on, and in the vicinity of Dartmoor, with results which, if not entirely satisfactory, are so to a great extent; they are briefly narrated on a subsequent page. In October and November various steps were taken to ascertain exactly what gauges were at work, and likely to be continued; on December 2nd the following letter was sent to the *Times* and to various local papers in districts badly represented:—

"BRITISH RAINFALL.

'To the Editor of

"SIR,—Can you find space for the enclosed extract from the Report of the Rain fall Committee, presented to the British Association at Exeter? And will you allow me to supplement it by the request that any persons who may be recording the fall of rain, or intending to record it, who are not already in communication with me, but are willing to assist by forwarding copies of their observations, will at once oblige me with their names and addresses, so that duplicate gauges may not be started unnecessarily near to them?

"As soon as possible after the receipt of the replies to this letter, I shall have to ask you further to oblige me by inserting a list of places whence observations are urgently required.

"I am, Sir, your obedient Servant, G. J. SYMONS.

62, *Camden Square, N.W., Dec.* 2, 1869."

As on many previous occasions, the local press most kindly assisted, and many additional observers were discovered through their instrumentality; by the middle of December most of the answers to this letter had been received, and the following one was prepared and similarly circulated:—

"BRITISH RAINFALL.

"To the Editor of

"SIR,—In accordance with the second paragraph of the letter which I had the honour of sending you on the 2nd instant, I beg to annex list of localities whence observations are 'urgently required.'

"I am, Sir, your obedient Servant, G. J. SYMONS.

62, *Camden Square, N.W., Dec.* 22, 1869.

CORNWALL—*Falmouth,* Jacobstow.
DERBY—Castleton
DEVON—*Hatherleigh,* Hartland, Exmoor.
DORSET—Bere Regis.
OXFORD—*Thame.*
SURREY—*Redhill.*
SUFFOLK—Halesworth, Mildenhall.
LINCOLN—Kirton.
NOTTINGHAM.—*Mansfield.*
WARWICK—*Stratford-upon-Avon.*
SHROPSHIRE—*Bishop's Castle.*
YORKSHIRE—*Milford Junction, Pately Bridge, Kettlewell, Askrigg,* Driffield, Bridlington, on the North York Moors.
LANCASHIRE—Broughton.
NORTHUMBERLAND—Haltwhistle.
CUMBERLAND—Kirkoswald.
WESTMORELAND—Ravenstonedale.
ISLE OF MAN—*Any part of the Island.*
PEMBROKE—*Tenby,* Fishguard.
CARDIGAN—Aberaeron.
BRECKNOCK—Llanwrtyd.

RADNOR—Builth, Knighton.
MONTGOMERY—Montgomery, Llanfyllin.
MERIONETH—Barmouth, Harlech.
CARNARVON—Pentrevoelas.
WIGTOWN—Northern part of.
KIRKCUDBRIGHT—Western part of.
PEEBLES—*Peebles*, Biggar.
AYR—*Muirkirk.*
ARGYLL—Mull of Cantire, Ballimore, *Glencoe*, near Ben Cruachan.
PERTH—*North-west part of.*
FORFAR—Western part of.
INVERNESS—Along the Caledonian Canal, and in Lochaber.
ABERDEEN—*North-west part of.*
NAIRN—*Any part of.*
BANFF—*Southern part of.*
ROSS—*Any place inland, or in Lewis or Harris.*
SUTHERLAND—*Any place inland.*
CAITHNESS—Any place inland.
IRELAND.—Except from the vicinity of Belfast, Dublin, Londonderry, and Waterford, where there are many observers, returns are required from nearly all parts of the country. (Several new stations started.)

Those of the localities above mentioned of which the names are printed in italics, have been provided with one or more observers, and many others have been secured for other districts; but it scarcely seems necessary to give here a list of them, since in our next annual volume their returns will, it is to be hoped, all be found in their respective places in the general tables.

I shall be greatly obliged to any one who will assist me in obtaining observers in the localities not yet provided, and therefore not printed in italics.

Height above Sea Level.—Under the joint influence of the rapid progress of the detailed levelling of the ordnance survey, under the direction of Capt. Edward James, R.E. (to whom we are indebted for much valued help), and the extensive adoption of the plan suggested in *British Rainfall*, 1868, p. 9, considerable improvement has been effected in the returns under this head. I wish, however, to approach still nearer to perfect accuracy, and hope my observers will second my efforts. Cheerfully renewing the offer of assistance made last year, I venture to supplement it by requesting that enquiries on the subject be sent during the spring and summer, and not when I am almost overwhelmed with work in the preparation of these tables.

Completion of the Decennial Period, 1860—1869.—My readers are aware that for rainfall purposes a grouping has been adopted, which makes each decennial period terminate with the close of the year 9,

such as 1809, 1819, &c., therefore the returns tabulated in subsequent pages complete that for 1860—69, and I find that some persons expect that the mean results for the period will be given in this annual. They little know the care requisite to ensure even that approach to accuracy which I endeavour to maintain, or they would not entertain such an idea. A table of such averages might be prepared in a couple of days, but it would inevitably be followed by such a table of errata, as has not yet appeared in these pages. Before I print these averages, upwards of twelve thousand columns of figures must be added and their means taken, and more than a quarter of a million figures must be checked. This is not work to be done in a week or two. And desirable as it is that these averages should be speedily computed, it is even more so that they should be as correct as it is possible for them to be. Moreover the "Comparison" table given on a subsequent page contains the averages of about a hundred stations for the periods 1840-9, 1850-9 and 1860-65, as well as the relation of the year 1869 to the last-named period.

Hourly frequency of rain.—The desirability of obtaining even approximate information as to the duration of rainfall, has been pointed out in these pages on more than one occasion. Mr. Gaster has especially urged it, as the only possible link between observations on land and at sea, and Mr. Glaisher has recently contributed to the *Proceedings of the Meteorological Society*, discussions of the records of the rain gauge attached to Osler's anemometer, at the Royal Observatory, Greenwich. By self-recording instruments alone can satisfactory records be obtained, and for this as well as for many other reasons, we rejoice at the rival efforts now making to produce a good self-registering rain gauge, at such a price as shall not be hopelessly prohibitory to the generality of observers. In the meanwhile, Mr. F. E. Sawyer, of 55, Buckingham Place, Brighton, has designed a form for the purpose of recording the duration of rainfall, which he will be pleased to forward to any one communicating with him who would make observations and record them for him. Each form is ruled for one month, and for the 24 hours in each day; a line is to be made across each hour or portion of an hour during which rain falls, and at the end of each day the sum of the hours of rain is to be made up. The duration of the rainfall being registered, it will be more easy to see the maximum rainfall in the minimum time. Mr. Sawyer registered in July, 1869, $1\frac{1}{2}$ hours of rain, in August, $27\frac{1}{2}$ hours, in September, $42\frac{1}{4}$ hours, in October, 30 hours, in November, $84\frac{1}{2}$ hours, and in December, $75\frac{3}{4}$ hours.

handsome offer was cheerfully accepted, and the construction of the following instruments was decided upon :—

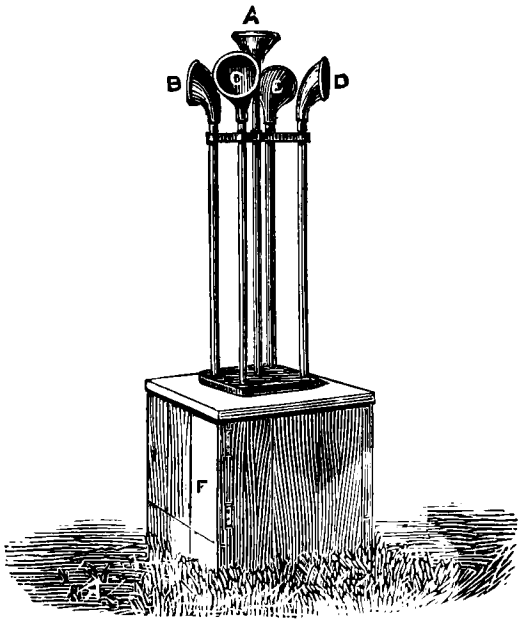


Fig. 1.

FIVE-MOUTHED GAUGE, fig. 1 (*marked* G *in view and ground plan*). —This instrument closely resembles one constructed more than thirty years since for Prof. Phillips's experiments at York. It has, as its name implies, five distinct funnels, each having a separate receptacle for the rain collected. One of these funnels has its orifice horizontal, the other four have their orifices vertical, and face the cardinal points. Therefore, if rain falls perpendicularly, A collects the whole, and B, C, D, E, collect nothing. If B, C, D, E, are respectively supposed to be the mouths facing S., W., N., and E., and rain falls from the N. at an angle of 45°, equal quantities will be collected by the funnels A and D; if the quantities collected by these two funnels are unequal, the ratios of the amounts collected enable one readily to calculate the altitudinal angle at which the shower has fallen. A similar method applies to the several vertical mouths, so that by this instrument the angle both of altitude and azimuth whence the rain has fallen can be determined.

INCLINED GAUGES, fig. 2 (*and* H, I, K, L *in view and plan*).—Of these, one only (45°) was originally suggested, but three were added subsequently, so that there are now four; the mouths being inclined to the horizon $22\frac{1}{2}°$, 45°, $67\frac{1}{2}°$, and 90°; the original 45° gauge is the

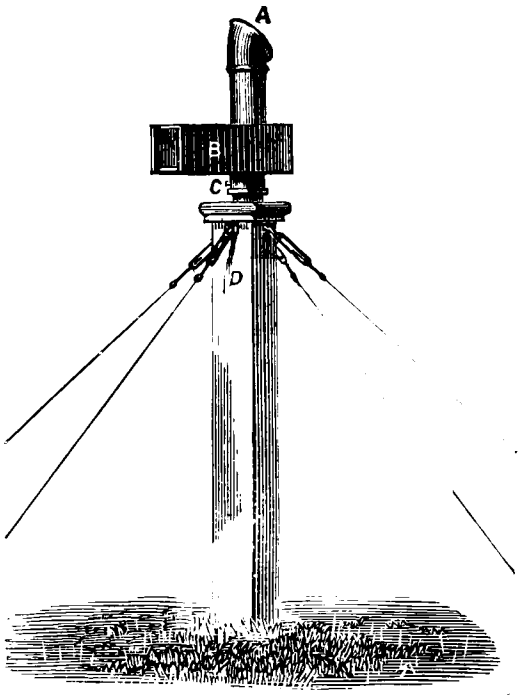


Fig. 2.

one represented by fig. 2. It will be seen to consist of a stout post D, supporting a pivot at C, on which all the upper part rotates; the mouth A is permanently inclined 45° to the horizon, and it is kept face to the wind by a powerful wedge shaped vane, B. The other inclined gauges only differ from the one represented in the angle of the orifice, which of course in the case of that at 90°, is actually vertical.

TIPPING-FUNNELLED GAUGE, fig. 3 (M *in view and plan*).—It is evident that the maximum amount should be collected by a gauge kept both in altitude and azimuth exactly at right angles to the path of the rain. None, however, but those who have tried it, can imagine how difficult it is to effect this even approximately. Some idea thereof may be formed from the annexed engraving, which represents the instrument in its present form; A is the receiving surface, which is rigidly attached to a horizontal axle, through the extremities of which pass two levers B B′, having at B′ a pair of vanes counterbalanced by the sliding weights C; both vanes and counterpoises can be clamped on any part of the levers, so as to enable the observer infinitely to vary their power over A. Of course, everybody sees at once, that in a dead calm the rods B B will be vertical, and the mouth of the gauge horizontal; if any wind arises it will act upon the vane F, and bring the gauge into position; then the fans B′ will be driven back by the wind, and the funnel A will rise to meet the rain; in the case of a hurricane the levers

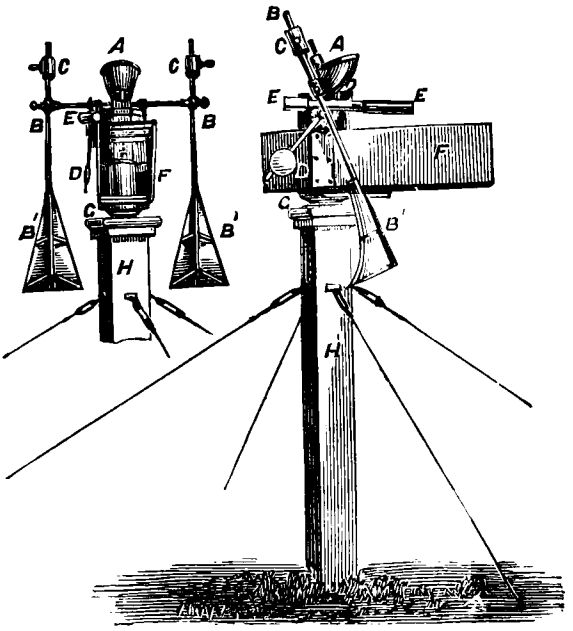


Fig. 3.

would become almost horizontal, and the mouth of the gauge vertical.

It was found, however, that some further steadying was required, to enable the apparatus to meet the complication arising from the continuing impetus of the rain-drops during a lull. This has been mitigated, if not entirely overcome, in a very ingenious manner. A weight D was first added, set on at not quite a right angle to the levers B B′, and then there was added thereto a brass tube E E, enclosing a glass one containing mercury; over the axial point of the glass tube there is a bridge, having a small hole in the bottom as in fig. 4. When the mouth A is tilted up, the mercury passes over the bridge into the small end, which thus becomes the heavier, and it is only as it gradually runs back through the small hole that the funnel A is able to resume its horizontal position.

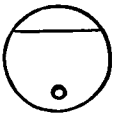


fig. 4

The above, with the addition of a small Robinson's anemometer (N), were the instruments originally started.

Subsequently, not only have the three inclined gauges already mentioned been added, but also a larger anemometer (O), a vane (P), thermometers (Q), an office (R), and a dozen gauges at different heights above the ground, viz., two at each of the following, 1 ft. (A), 5 ft. (B), 10 ft. (C), 15 ft. (D), 20 ft. (E), and 25 ft. (F). Duplicates are placed at each height, in order to compare monthly and daily readings.

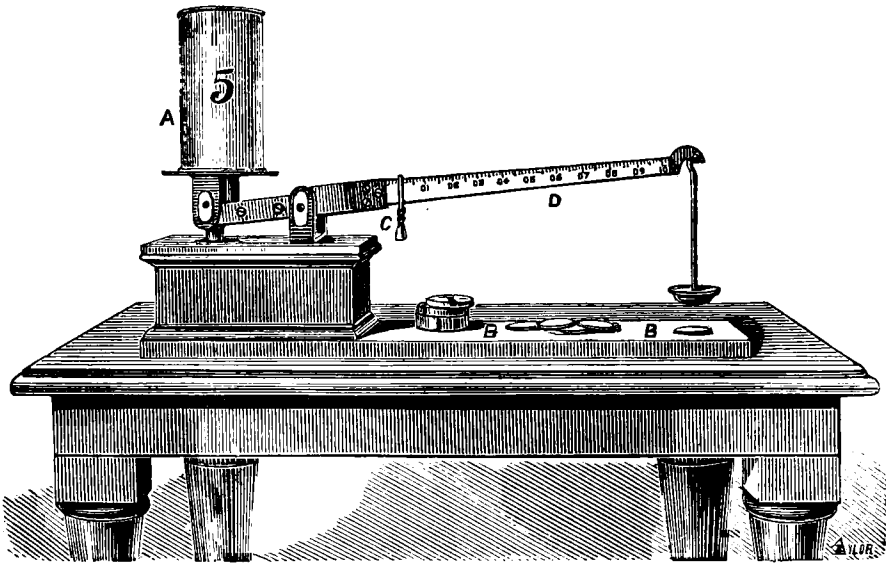


Fig. 5.

Lastly, with a view to securing *perfect* accuracy in all the measurements (even to 0·001 in.), each gauge was numbered, a duplicate series of cans were provided, and similarly numbered and adjusted, till their weights were all identical. One set of cans is, therefore, always in the gauges, and the other set in a box prepared for them. When an observation has to be taken, all that has to be done out of doors is to exchange the cans. The full ones are then taken into the office and placed on the weighing-machine, fig. 5, which is provided with weights, B for each 0·10 in., and a sliding one C for the fractional parts, the steel-yard D being divided to show by simple inspection each thousandth of an inch.

RAIN GAUGE EXPERIMENTS, BOSTON RESERVOIR, ROTHERHAM.

Lat. 53° 25′ N., Long. 1° 20′ W. 381 ft. above the Sea Level.

FOR THE YEAR 1869.

	FIVE MOUTHED GAUGE.					INCLINED ROTATING GAUGES.				
Height above ground.	5ft.					5 ft.				
Months.	Facing East.	Facing North.	Facing West.	Facing South.	Horizon Centre.	22½°	45°	67½°	90	Tipping
January	·370	·406	·818	2·243	2·596	3·266	3·596	3·231	2·406	3·376
Feb. ...	·221	·620	1·270	·699	1·488	2·140	2·519	2·494	1·976	2·579
March..	1·200	2·901	·340	·247	1·278	2·704	3·703	4·156	3·882	2·828
April ...	·370	·478	·504	·406	1·496	1·853	1·911	1·708	1·178	1·878
May ...	3·996	3·758	·159	·070	5·167	7·277	8·078	7·798	6·684	7·273
June ...	·018	·360	·354	·056	·824	·990	1·007	·817	·540	1·039
July ...	·000	·000	·019	·025	·086	·104	·073	·065	·029	·097
August.	·059	·198	·311	·347	1·699	1·917	1·697	1·254	·622	1·842
Sept. ...	·074	·143	·763	1·146	3·578	4·010	3·884	3·136	1·850	4·121
October	·290	·234	·184	·227	1·168	1·392	1·360	1·123	·651	1·431
Nov. ...	·133	·480	·660	·655	1·729	2·065	2·246	2·237	1·567	2·376
Dec. ...	·946	1·199	1·051	1·659	2·948	4·066	4·824	4·908	3·862	4·468
Totals..	7·677	10·777	6·433	7·780	24·057	31·784	34·898	32·927	25·247	33·308

ELEVATED GAUGES.

Height above ground	1 ft.			5 ft.			10 ft.		
Months.	Read Daily.	Read Mnthly.	Diff.	Read Daily.	Read Mnthly.	Diff.	Read Daily.	Read Mnthly.	Diff.
January.....	2·707	2·690	—·017	2·511	2·486	—·025	2·477	2·460	—·017
February	1·690	1·669	—·021	1·472	1·473	+·001	1·364	1·373	+·009
March	1·535	1·667	+·132	1·276	1·354	+·078	1·154	1·405	+·251
April	1·596	1·620	+·024	1·489	1·475	—·014	1·411	1·413	+·002
May	5·280	5·442	+·162	5·116	5·117	+·001	4·848	4·984	+·136
June	·877	·881	+·004	·826	·832	+·006	·792	·802	+·010
July	·119	·054	—·065	·087	·115	+·028	·085	·114	+·029
August	1·756	1·777	+·021	1·704	1·699	—·005	1·668	1·700	+·032
September.....	3·715	3·642	—·073	3·487	3·489	+·002	3·439	3·458	+·019
October	1·313	1·273	—·040	1·164	1·158	—·006	1·132	1·120	—·012
November... ..	1·788	1·788	·000	1·670	1·645	—·025	1·531	1·499	—·032
December	3·044	2·960	—·084	2·785	2·731	—·054	2·607	2·553	—·054
Totals	25·420	25·463	+·043	23·587	23·574	—·013	22·508	22·881	+·373

RAIN GAUGE EXPERIMENTS, BOSTON RESERVOIR, ROTHERHAM.

(*Continued.*)

ELEVATED GAUGES—(*con.*)

Height above ground	15 ft.			20 ft.			25 ft.		
Months.	Read Daily.	Read Mnthly.	Diff	Read Daily.	Read Mnthly.	Diff.	Read Daily.	Read Mnthly.	Diff.
January.....	2·404	2·442	+·038	2·439	2·442	+·003	2·434	2·453	+·019
February	1·317	1·355	+·038	1·280	1·304	+·024	1·229	1·225	—·004
March	1·184	1·270	+·086	1·099	1·200	+·101	1·091	1·128	+·037
April	1·371	1·392	+·021	1·358	1·397	+·039	1·335	1·376	+·041
May	4·897	4·873	—·024	4·680	4·800	+·120	4·752	4·843	+·091
June	·783	·813	+·030	·774	·796	+·022	·757	·795	+·038
July	·081	·106	+·025	·076	·122	+·046	·070	·108	+·038
August	1·656	1·682	+·026	1·618	1·669	+·051	1·604	1·629	+·025
September... ..	3·371	3·407	+·036	3·344	3·370	+·026	3·292	3·319	+·027
October	1·096	1·119	+·023	1·081	1·083	+·002	1·048	1·075	+·027
November.....	1·465	1·503	+·038	1·442	1·446	+·004	1·405	1·384	—·021
December	2·547	2·541	—·006	2·467	2·445	—·022	2·432	2·395	—·037
Totals	22·172	22·503	+·331	21·658	22·074	+·416	21·449	21·730	+·281

R. CHRIMES.

INTERPRETATION OF THE ROTHERHAM RECORDS.

Having thus fully described the apparatus employed, and given an abstract of the results for 1869 in the same form as in previous years, I intend in the next place to explain what *appear to me* to be the facts proved by the observations; this I desire to do in the clearest and most simple manner possible. I have put the words "appear to me" in italics, as an indication that others may possibly dispute some of the inferences drawn in the next few pages. I should rather rejoice if such should be the case, because nothing elicits truth better than a brisk discussion. Having inserted in this and previous issues of *British Rainfall* the whole of the monthly results obtained, it is only necessary on the present occasion to collect those elements which appear to be of the highest importance. Any one else who will take up the investigation will have no difficulty in finding materials for many a puzzling question.

TABLE I.—*Abstract of Monthly Results*, 1866-69.

DATE.	Mean Angle from vertical.		Inclined Gauge which—		Rain at 1 ft. being 100 Rain at 25 ft. =	Mean velocity of wind on days with rain.
			Collected most.	Should have collected most.		
	deg.	min.	deg.	deg.		miles per day
1866... April	54	45	45	...	89	164
May	50	22	67½	45	78	192
June	35	51	45	...	93	123
July	32	40	22½	...	94	103
August	34	19	45	...	88	137
September.....	25	5	22½	...	92	107
October.....	28	18	45	22½	95	114
November.....	45	26	45	...	83	180
December	42	26	45	...	80	197
1867.. January.....	...	...	...	...	...	...
February	46	19	45	...	78	174
March	69	33	67½	...	68	193
April	41	28	45	...	83	211
May	40	00	45	...	90	166
June	29	33	22½	...	92	115
July	27	25	22½	...	91	97
August	17	29	22½	...	97	84
September.....	22	34	22½	...	93	106
October.....	29	59	22½	...	88	105
November.....	32	33	45	22½	86	153
December	60	17	67½	...	81	164
1868...January.....	58	32	67½	...	70	156
February	54	27	45	...	78	225
March	50	18	45	..	76	206
April.....	50	46	45	...	86	177
May	15	5	22½	...	88	80
June	7	20	22½	0	88	66
July	14	45	22½	...	79*	93
August	26	23	22½	...	91	126
September.....	48	57	45	...	92	146
October.....	35	9	45	...	86	139
November	51	32	67½	45	71	151
December	43	51	45	...	91	161
1869...January..	42	49	45	...	90	159
February	53	1	45	...	73	198
March	71	47	67½	...	71	263
April.....	38	13	45	...	84	163
May	52	18	45	...	90	157
June	33	14	45	22½	86*	117
July	18	38	22½	...	59	78
August	20	6	22½	...	91	125
September.....	27	20	22½	...	89	118
October.....	29	8	22½	...	80	152
November.....	42	11	45	...	78	194
December	52	39	67½	45	80	195

* In these months the total fall was less than a quarter of an inch; the daily and monthly gauges differ exceedingly, and owing to high temperature, there appears to have been some little evaporation in the longer tubes; these values are therefore doubtful.

TABLE II.—*Angle from vertical.*

Date.	1866		1867		1868		1869		Mean.	
	deg.	min.	deg.	min.	deg.	min.	deg.	min.	deg.	min.
January	...		...		58	32	42	49	50	40
February.....	...		46	19	54	27	53	1	51	15
March	...		69	33	50	18	71	47	63	53
April	54	45	41	28	50	46	38	13	46	18
May.....	50	22	40	00	15	5	52	18	39	26
June.....	35	51	29	33	7	20	33	14	26	29
July...	32	40	27	25	14	45	18	38	23	22
August..	34	19	17	29	26	23	20	6	24	34
September ...	25	5	22	34	48	57	27	20	30	59
October	28	18	29	59	35	9	29	8	30	39
November ...	45	26	32	33	51	32	42	11	42	55
December ...	42	26	60	17	43	51	52	39	49	48
Mean	38	48	37	55	38	5	40	7	40	1

TABLE III.—*Rain at* 1 *ft. being* 100, *rain at* 25 *ft.* =

Date.	1866	1867	1868	1869	Mean.
January	...	...	70	90	80
February... ..	...	78	78	73	76
March	...	68	76	71	72
April	89	83	86	84	86
May.....	78	90	88	90	87
June.....	93	92	88	86	90
July.....	94	91	79*	59*	92
August.....	88	97	91	91	92
September ...	92	93	92	89	92
October	95	88	86	80	87
November ...	83	86	71	78	80
December ...	80	81	91	80	83
Mean	88·0	86·0	83·8	82·9	84·8

TABLE IV.—*Mean velocity of wind in miles per diem on days with rain.*

Date.	1866	1867	1868	1869	Mean.
January	...	...	156	159	158
February.....	..	174	225	198	199
March	...	193	206	263	221
April	164	211	177	163	179
May.....	192	166	80	157	149
June	123	115	66	117	105
July.....	103	97	93	78	93
August	137	84	126	125	118
September ...	107	106	146	118	119
October	114	105	139	152	128
November	180	153	151	194	170
December.....	197	164	161	195	179
Mean	146	143	144	160	152

* See note on previous page.

TABLE V.—*Monthly ratios of rain at 1 ft. and 25 ft. grouped according to the mean angle at which the rain fell 5 ft. above the surface.*

Angle from Vertical.	Per Centages (from Table III.)	Mean.	
0° to 5°	.....	...	
5 10	88.....	88	
10 15	...	...	
15 20	97, 88, 59	81	88
20 25	93, 91	92	
25 30	92, 95, 92, 91, 88, 91, 89, 80	90	
30 35	94, 88, 96	89	
35 40	93, 90, 86, 84.....	88	
40 45	80, 83, 91, 90, 78	85	
45 50	83, 78, 92	84	
50 55	89, 78, 78, 76, 86, 71, 73, 90, 80	80	
55 60	70....	70	77
60 65	81.....	81	
65 70	68.....	68	
70 75	71.....	71	

TABLE VI.—*Mean monthly velocity of wind on days of rain, grouped according to the mean angle at which the rain fell 5 ft. above the surface.*

Angle from Vertical.	Mean Velocity (from Table IV.)	Mean.	
0° to 5°	.....	...	
5 10	66.....	66	
10 15	93	93	
15 20	84, 80, 78	81	106
20 25	106, 125	116	
25 30	107, 114, 115, 97, 105, 126, 118, 152	117	
30 35	103, 137, 153, 117..	128	
35 40	123, 139, 163	142	
40 45	197, 211, 166, 161, 159, 194	181	
45 50	180, 174, 146	167	
50 55	164, 192, 225, 206, 177, 151, 198, 157, 195 ...	185	
55 60	156	156	187
60 65	164	164	
65 70	193	193	
70 75	263	263	

We can examine the monthly values given in Table I., most conveniently by the aid of the subsequent Tables II., III., and IV., but before passing to them we ought to draw attention to the fourth column of Table I., inasmuch as the information it affords is not subsequently noticed. This column shows which of the four inclined gauges ought (according to calculations based on the other gauges) to have collected most. Only seven entries will be found in this column, because in all the other 37 instances, the gauge which *ought* to have collected most, really did so. And when we point out that two of these exceptions are so, only by about 1° of angular elevation, and that the whole

of them are in error less than 5°, sufficient proof is afforded of the accuracy of the instruments, observations and calculations. In Table II. we have the mean angle from the vertical at which rain fell in each month during the four years, and the mean for the whole period. From it we find that the angle from the vertical is greater in March than in any other month, and less in July and August than in any other months. We see also that (even on the average of a whole month) the inclination of rain varied from 7° 20′ in June, 1868, to 71° 47′ in March, 1869, the range being 64° 27′. The average angle for each year is, however, very steady, the difference being only 2° 12′ (40° 7′ — 37° 55′).

In Table III. we have a compact view of the monthly variation between two gauges at different heights, the amounts collected in the upper gauge being expressed in per-centages of those collected in the lower.

Hence we find that the difference between the amount collected by the two gauges is on an average 15 per cent., but in March it is nearly twice the amount (28 per cent), and in the summer months scarcely half (8 per cent.) If we examine individual months, we shall find still wider differences in the spring months (32 per cent. in March, 1867), and closer agreement in the summer months (3 per cent. only in August, 1867). The yearly average only varies 5 per cent., viz, from 82·9 to 88·0, = 12 to 17 per cent. deficiency in upper gauge. From this some light is obtained as to the probable nature of the corrections required by Mr. Gaster, for his investigations into the monthly per-centage of mean annual fall.

Table IV. only requires to have its imperfection pointed out. It gives correctly all that it professes to give, and as I shall presently show, throws considerable light on the cause of the indications of the previous tables; but still it is imperfect, and it is so on this wise:— If we wish to ascertain the reason for, or the conditions which accompany, certain irregularities in the amount of rain collected in various gauges, we require to know what were the conditions during the time the rain was falling, not those which prevailed for twenty-four hours, in only two (perhaps) of which the rain actually fell. In short, we require the velocity of the wind during the time of rain, and not the average velocity during the day. This, however, can only be obtained by the erection of a Kew anemometer, and the application of self-recording apparatus to the rain gauges, which would involve an outlay of time and expense which I cannot recommend, besides which, the records would become so complicated, that their analysis would require at least one person's whole time.

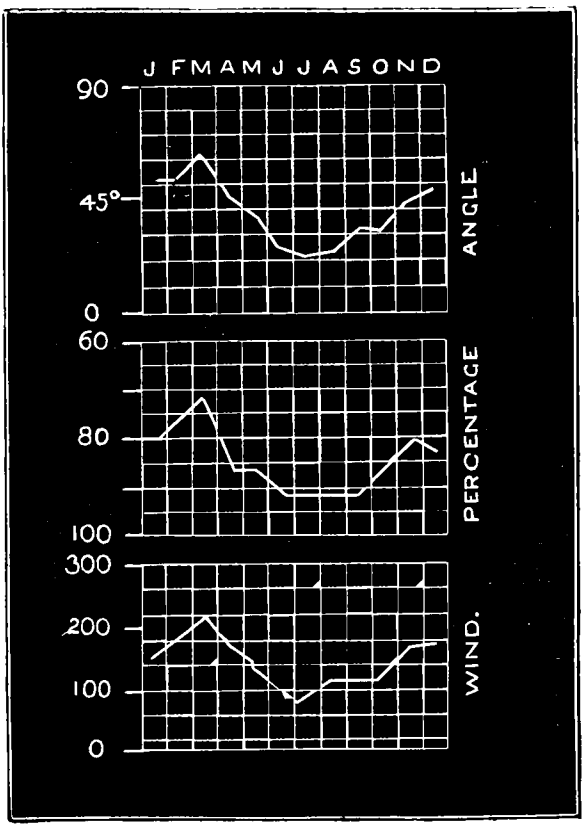


Fig. 6.

Fig. 6 embodies the results of the tables we have been considering, and the similarity in the form of the curves of the three elements is such as to need no further comment.

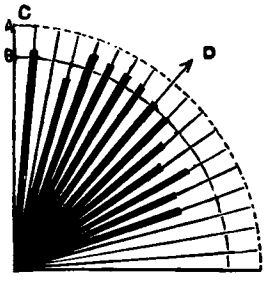
The results may, however, be exhibited in a different form. The mode of arrangement adopted in Table V. (although exhibiting irregularities) shows that when rain falls more nearly vertical than usual the upper gauge catches a larger per-centage of rain than usual, and when the rain is driven more horizontally than usual, the upper gauge catches less than usual. The mean angle from the vertical being 40°, it appears from this table that on the average of those months when rain fell at a less angle than 40°, the upper gauge collected 88 per cent. of the amount caught by the lower one, and when the rain fell at a greater angle than 40°, the upper gauge only collected 77 per cent.

Table VI. is similar in form to Table V., and shows that with rain falling at a small angle from the vertical, the velocity of the wind is little more than half what it is when the rain falls at a greater angle.

These results are graphically shown in figs. 7 and 8. The thin radii indicate angles of 5° from the vertical, the dotted quadrant A,

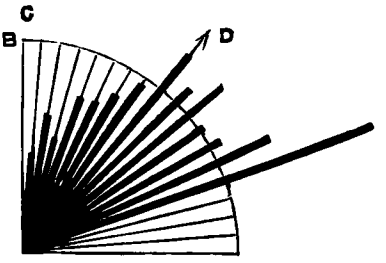
fig. 7 represents the average amount (= 100) of rain collected on the ground, the continuous quadrant B represents the average amount (= 85) collected 25 ft. above the ground; the length of the thick radii indicates the amount collected by the upper gauge in those months in which the average angle from the vertical was that indicated by the thin radii. To take an instance :—The vertical line is not thickened because there has been no month in which the rain has all fallen vertically; we must, therefore, pass to the second line ending near C; this thin line represents 5° angular deviation from the vertical, and reference to Table V. shows that when rain fell at that angle, 88 per cent. was collected by the upper gauge, or 3 per cent. more than the average.

The mean annual angle of falling rain (40° from the vertical) is represented by the arrow-head D.



Per-Centage.

Fig. 7.



Velocity of Wind.

Fig. 8.

Fig. 7, therefore, shows that when the rain falls at a less angle than usual, the upper and lower gauges differ much less than when the angle is greater.

Fig. 8 is constructed on a similar principle, the quadrant B representing the average velocity of the wind, and equally confirms the opinion which I have expressed as to the indication of Table VI.

I have, hitherto, been dealing only with monthly totals, but in order to ascertain if the daily amounts indicated a similar law, I have extracted from the daily records for 1869, all entries of rainfall on days when the wind was under 75 miles per diem, or above 300 miles. The following are the results :—

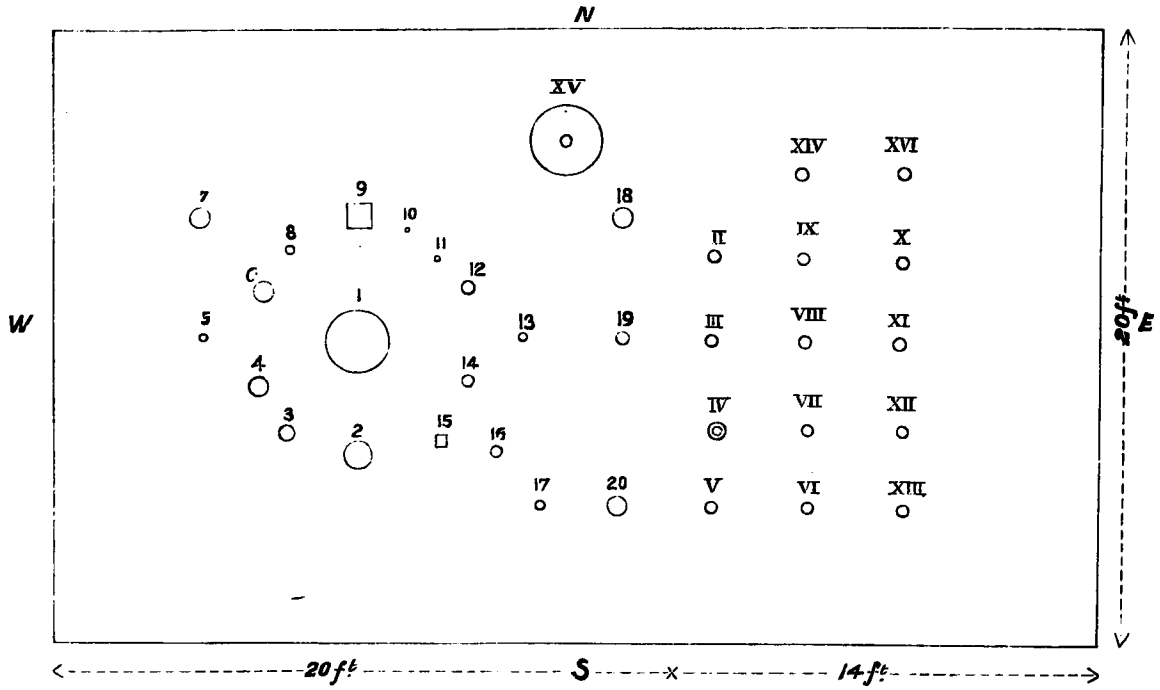
	Calm Days.	Calmest Day.	Rough Days.	Roughest Day.
Number of days	17	1	10	1
Average velocity of wind in miles, per diem.....	58	22	344	375
Angle from vertical.....	19° 25′	5° 7′	74° 11′	73° 18′
Per-centage of fall at ground, collected at 25 ft.	94·5	111·8	69·8	79·3

Here (except in the "roughest day," and we all know the rain by no means accompanies the time of strongest wind) we have the same co-relation manifested as we have already found in the monthly and annual means, and hence it appears to me undeniable; I leave it, however, for others to confirm or overthrow these inferences. It will be seen that on the calmest day the gauge at 25 ft. actually collected more than that at 1 ft. above the ground.

Azimuthal Direction of Rain.—This is of course readily computed from the reading of the 5-mouthed gauge, and is of considerable interest as a meteorological question, not, however, so far as I can trace, connected with the points previously touched upon. It is evident that its indications would differ widely from those of a similar instrument erected in one of the south-western counties, and that its main value is as an instrument for comparing results in different localities, in which respect it would be very interesting, and as a check upon the proper action of the vanes of the tipping and inclined-funnelled gauges.

Elevation Series.—In the present discussion I have only employed the observations of one pair of these gauges, viz., one at 1 ft., and one at 25 ft. It would, perhaps, have added to the precision of the deductions in the previous pages, if the whole twelve gauges had been used, but the gain in precision would have been of little moment, other elements, such as wind force, being known to be only approximate. Moreover, it would have involved such complex treatment, that what would have been gained in precision would have been more than counterbalanced by what would have been lost in clearness. An abstract of the results of the whole series for 1866 and 1867, was given in *British Rainfall* for the latter year, and having regard to the space already occupied by this article, I defer their detailed discussion for another year.

EXPERIMENTAL RAIN GAUGE ENCLOSURE, STRATHFIELD TURGISS, HANTS.



EXPLANATION.

No. on Plan.	Shape of Gauge.	Rim.	Diameter or side of square.
1	Circular	Upright...	24 in.
2	,,	,,	12
3	,,	,,	6
4	,,	,,	8
5	,, (Fleming's)	,,	3
6	,, (Glaisher's)	Flange A	8
7	,, ,,	,, C	8
8	,,	Upright...	4
9	Square	,,	10
10	Circular	,,	1
11	,,	,,	2
12	,, (Howard's)	Flange	5
13	,,	Upright...	3
14	,,	,,	5
15	Square	,,	5
16	Circular (Jagga Rao's)	,,	4
17	,, (Stevenson's)	,,	3
18	,, (Glaisher's)	Flange B	8
19	,, (Evaporator)	Upright...	5
20	,, (Glaisher's)	Flange D	8

No. on Plan.	Description.	Colour of Can.
II.	Long felt protected	White.
III.	Earthenware funnel	Black.
IV.	Wet sand protected	White.
V.	Rim at 45°	Black.
VI.	,, ,, 67½°	,,
VII.	No pipe to funnel	,,
VIII.	Copper funnel in earthen bottle	...
IX.	No bottle inside	Black.
X.	Ebonite	,,
XI.		White.
XII.	Rim at 22½°	Black.
XIII.		,,
XIV.	Glass funnel	,,
XV.	Crallan's	...
XVI.	Rim at 45° (Dup. of V.)	Black.

RAIN GAUGE EXPERIMENTS AT STRATHFIELD TURGISS, READING.

Lat. 51° 20′ 23″ N.; Lon. 1° 2′ 30″ W.; Height above Sea, 200 feet.

By the Rev. C. H. Griffith, F.M.S., &c.

At the conclusion of my last report I stated that the whole of the experimental gauges had been grouped together, for the year 1869, within one enclosure; this has been done in order to place the entire set of gauges resting on the ground, under as exactly identical conditions as possible.

The appended plan will give an idea of the positions they have thus occupied; the railings having been enlarged sufficiently on the E side to afford a clear space of at least 3 ft. in every direction between each gauge, and the same uniform height of 1 ft. from the ground has been carefully maintained.

The only difference that has been carried out in their observation has been, that as far as practicable, they have been read monthly instead of daily. This different method of treatment has produced a greater difference in the results than I should have expected, but it is easily accounted for on the ground that last year the *collecting* powers only of the gauges were put to the test, whereas this year, their powers of retaining what they had already collected have been brought to bear upon the results, and in some cases this has produced a considerable difference in the total amount. Two other chief courses also have appeared to me to have been at work to bring about this altered result; first, some of the gauges were not capable of retaining literally a month's rain, their receivers being only sufficiently large to retain with safety 2 in. of rain; whenever, therefore, from the readings of the daily gauges I perceived this amount had nearly been obtained, I read these gauges, even at irregular periods, rather than run the risk of overflow, those therefore that could with safety be left to retain the month's rain, were so left and read on the first day of the succeeding month, but those which were doubtful were read as soon as the point of danger was attained. Another cause which perhaps has had the effect of producing even greater amount of difference in the results, has arisen from the fact that some gauges when left for a month's collection, from their peculiar formation have allowed the collected rain to stand, so that evaporation from its surface has freely occurred, espe-

cially for instance in the case of the 24 in. gauge. This gauge, from the wide sweep of its collecting surface (purposely so constructed to avoid outsplashing) dipping deeply into its receiver, even with a small quantity of fall, has had a certain amount of water always standing in the neck of the pipe and lower extremity of the funnel, whence evaporation has freely taken place. This has, I believe, tended to reduce the total amount collected and retained in this gauge. The same may be said of the 10 in. square gauge, and indeed of several of the others. On the other hand, the 6 in. having only a comparatively small bottle receiver, was read much more frequently, and from its very sharp deep funnel and small-necked bottle, suffered not a whit from evaporation, hence I can only suppose its high reading. Another source of difference has perhaps arisen from the fact, that the receivers of some of these gauges were a year ago painted, in order to render their receiving surfaces similar, but the paint has proved a bad receiving surface, from the fact of its perishing very quickly, and in its disintegrated state sucking up a great deal of water.

The gauge that has collected, but which can hardly be said to have retained the most (as it was read daily), is Crallan's 5 in. zinc disc surrounded gauge; this has read higher than any other gauge, chiefly, I suppose, from the fact of its having been placed level with the actual ground itself. This gauge is intended to test the question of the counterbalance of outsplashing by insplashing, of which I spoke last year. What may be the merits or demerits of this hypothesis, I do not venture to decide; the chief objection that to my mind can be raised against this gauge is, that the outer surrounding disc is not so mathematically proportioned to the inner 5 in. rain collecting circle, that at least a correct balance may be provided, let the effect be what it may. The disc added by Mr. Crallan is 2 ft. 4 in. in diameter; this includes of course the 5 in. inner collecting circle; this is certainly too much, as the following simple calculation will show:—

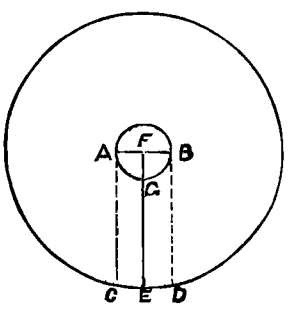


Fig. 9.

Of course it is premised that rain falling in any direction, will only supply the inner circle by insplashing in the direction in which the wind is blowing, or at the angle in which the rain is falling, and in breadth to the width of the 5 ins. of the receiver in that direction, whatever it be; thus, if we suppose the wind be blowing from E to F, the portion A B C D (minus the semicircle included in the 5 in. receiving circle) will be the only portion from which rain can insplash into the receiver.

Let A B = 5 ins., $\therefore$ radius $= \frac{5}{2}$ ins, what length must A C be, so that the figure A C D B = area of the inner circle.

Let A C $= x$

(Area of $\odot = \pi r^2$)

$$\therefore 5x - \frac{1}{2} \times \frac{25}{4}\pi = \frac{25}{4}\pi$$

$$5x = \frac{3}{2} \times \frac{25}{4}\pi$$

$$\therefore x = \frac{3 \times 5}{2 \times 4}\pi = \frac{15\pi}{8}$$

$= 5{\cdot}89048$ ins., or for practical purposes, say 6 ins.

(Assuming $\pi = 3{\cdot}14159$.)

This calculation ignores the slight curvature at C D, but this would be hardly appreciable in the result. Taking, therefore, F to be the centre of both circles F G = 2½ ins., F E = say, 6 ins., so that G E = 3½ ins.; the entire disc should, therefore, be 12 ins. in diameter, instead of 28 ins., as assigned by Mr. Crallan.

Another very apparent fault in this gauge, which greatly militates against its maintaining a true balance between insplashing and outsplashing, is that the perforated floor of the 5 in. central receiver is not perfectly level, but somewhat considerably curved downwards, thereby greatly diminishing its outsplashing power.

Of the other gauges it is unnecessary to say more than that, notwithstanding the probable causes of difference to which I have alluded, it is remarkable how nearly alike they have read. At times, however, they have read differently, especially in seasons of high wind and driving rain, it is, therefore, a matter of very great satisfaction to me, that they are now removed to Whitby, in the care of Mr. Stow, who lives, I believe, in one of the most boisterous places in England, so that the effect of wind which I already perceive to be considerable, may be effectually worked out. From the inland and sheltered position of my Rectory, this point has not received any elucidation here.

Jagga Rao's gauge has disappointed me, being low in the scale, although it has a good surfaced receiver, viz., copper. It appears, however, from the delicate measurement of Mr. Symons, that the glass measure with which it is read is graduated according to its *supposed*, but which turns out to be not its correct, diameter; this may elucidate the mystery.

Fleming's gauge, too, has broken down. I believe the gauge ought to have taken rank among the highest collecting gauges, but in November I detected a flaw in the float, whereby the registration of quite an inch of rain was lost, the water permeating the hollow metal float, and sinking it so that it read very considerably too low.

Stevenson's gauge too I fear must be condemned, although I must admit it is formed on a principle which I cannot profess to understand. The inventor claims credit for it on the ground that the rim and funnel "assume a symoidal section."* Now what this peculiar formation may be, I am wholly unable to say. I have hunted carefully through every possible book, and enquired diligently of every likely person, but can learn nothing whatever about "symoidal." I have even referred the matter to the Mathematical Professor of the University of Cambridge, but with a similarly negative result. It has been suggested to me, that the inventor may mean "sigmoidal," that is like the letter "Σ" in form, but as the gauge has not that peculiarity of form, this suggestion cannot be correct. I have, therefore, been obliged reluctantly to relinquish the elucidation of the matter; but whatever the principle may be on which this instrument is designed, I am obliged to add that it is faulty, as the gauge only registers amongst those known to be very bad. Another very great fault in this form of receiver is to be found in the deeply receding flange inserted immediately below the receiving aperture; this causes very considerable eddy-windage. I have on several occasions amused myself by inserting two or three pith balls, such as I had made for electrical experiments, into the receiver, during a heavy gale of wind without any rain, and have been exceedingly entertained in watching their evolutions while spinning round with the revolving eddy. This result I could not obtain in any other form of receiver in my possession, neither do I think it a kind of result desirable to be obtained, under any circumstances connected with the accurate admeasurement of rainfall. One use, however, I have discovered for the gauge, although it might not probably have been designed by the inventor—it is the best insect trap I ever knew; I have collected out of its receiver nearly 100 insects for dissection for my microscope, some of them rare, together with a very fine collection of slugs.

Of the material series very little need be said, the results obtained this year coinciding very nearly with those of last year, with the exception of the earthenware receiver or funnel; this has not collected anything like so much as last year, and from the reason I then assigned, viz., that the funnel is not a regularly formed rain gauge receiver, but an old apothecary's funnel, with the usual ridges on its sides adapted as a rain gauge; the rain collects on these ridges and evaporates. Also, I have not kept the small tin disc on the very large aperture of the

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* See *Meteorological Magazine*, June, 1869, p. 80.

funnel as heretofore, whence evaporation is easy, and again, the cement joining the earthenware to the brass rim has perished considerably; all these circumstances are quite sufficient to account for the diminished quantity collected, but I do not think the material is to be condemned on this account, but the present form of it is decidedly bad.

No VII. affords a peculiarly instructive lesson on the necessity of a long narrow pipe and small aperture of funnel; this gauge has no pipe, and the aperture of the funnel has been widened for this year to the extent of half-an-inch to test the result. I find in its altered state it gives a reading of 22·135 against 26·530 ins.

The roof gauges have been as eccentric in their behaviour this year as during 1868, affording any result you please, from 18·700 up to 25·089. I think we perforce must learn hence that records kept from the observation of gauges placed on the roofs of buildings must be received with caution.

On the whole, therefore, I am glad to be able to say, that with the exceptions mentioned, I have no cause to come to a conclusion differing from that obtained last year; in fact, even under trying circumstances of weather, there is no reason, as far as I can see, to consider that the size of the gauge, all other things considered being equal, in any way affects its readings, save and except where from its very minute size, mechanical difficulties of measurement arise, provided always that the gauge have an upright sharp edge, without any flange or shelving angle, and is kept perfectly level.

As regards material, I still think that no better receiving surface can be desired than either ebonite or copper; it is difficult to say which is the better of the twain. The ebonite gauge of this set is in as good a condition as regards surface, and as true in figure, as on the first day it was erected, but the copper has collected this year ·087 more than the ebonite; this difference, however, is so very slight, they may I think fairly be said to be equal.

There have not occurred this year at this station, any very remarkably heavy rainfalls in short periods needing especial comment. I look forward, however, to the next year, in the hope that there may be a fall of this kind, perhaps, as an accompaniment to some sharp thunderstorm, in order to watch closely for the maximum amount of fall in the minimum time, a point of great importance to the engineer and designer of water works, &c.; as it is thought we may some day receive a far greater fall in the 24 hours than we have of late experienced, I am provided with a most admirable gauge for the purpose of practically testing this matter; I mean "Symons's Storm Gauge,"

described in my last year's report, p. 28. I find objections have been raised to this form of gauge, from the liability to breakage of the glass tubes from frost, &c. This is an invalid objection, and an unnecessary occurrence, as the insertion of say, half an ounce of common salt into each tube, entirely prevents the possibility of breakage from the hardest frost; my storm gauge thus "pickled," has stood every frost of last and this year, without any damage whatever.

The only experimental gauges now remaining here are those forming the elevation series, these have been retained, as it was considered desirable to continue the observation of their eccentricities for at least another twelve months.

It will be noticed that the records of the material and magnitude series only extend to December 20th, on which date they were taken down for removal to Hawsker, near Whitby. The elevation series (as just mentioned) have been retained here, but for the convenience of comparison they have, in the following tables, been made up to the same date, the remaining days of December being separately added.

ABSTRACT OF RAINFALL FOR THE YEAR 1869 AT STRATHFIELD TURGISS, HANTS.

MATERIAL SERIES.

NOTE.—All these gauges are 5 inches diameter, and with the exceptions noted, are black can gauges with glass bottle receivers, and the funnels 1 ft. above the ground.

Numbers attached to each gauge ...	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	
Description of gauge.	3 ft. above ground, tin pot receiver.	Long white protected	Earthenware Funnel.	White can, Wet sand, protected.	Rim at 45°	Rim at 67½°	No pipe.	Copper funnel, Earthen bottle	No bottle.	Black Ebonite.	White can, Upright rim.	Rim at 22½°	Black can	Glass funnel.	Crallan's, On the ground.	Duplicate of No. V, Read monthly.	Evaporation.
Months.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
January	3·184	3·331	3·189	3·251	3·277	3·200	2·941	3·380	3·210	3·365	3·324	3·206	3·204	3·320	3·551	3·381	2·223
February.....	2·341	2·280	2·366	2·305	2·329	2·296	2·172	2·376	2·263	2·354	2·406	2·342	2·356	2·343	2·546	2·348	1·573
March	·926	·956	·957	1·017	1·062	1·039	·934	1·087	1·025	1·059	1·083	1·070	1·090	·984	·984	·983	2·357
April	1·118	1·106	·973	1·118	1·156	1·131	·932	1·166	1·086	1·208	1·167	1·150	1·162	1·203	1·195	1·115	2·866
May.....	3·315	3·296	3·084	2·982	2·957	2·970	2·028	3·284	2·833	3·325	2·973	3·204	3·201	3·345	3·392	3·406	3·273
June	1·378	1·422	1·230	1·534	1·465	1·470	1·251	1·465	1·383	1·496	1·460	1·425	1·480	1·449	1·444	1·487	5·462
July.....	·719	·623	·599	·744	·696	·705	·498	·775	·555	·795	·713	·698	·678	·681	·897	·741	6·875
August	1·213	1·246	1·159	1·299	1·287	1·289	·981	1·305	1·119	1·311	1·287	1·299	1·298	1·289	1·320	1·301	5·888
September	4·166	4·281	4·110	4·200	4·157	4·187	3·507	4·391	4·000	4·399	4·376	4·366	4·279	4·353	4·277	4·389	4·873
October	1·569	2·237	2·138	2·319	2·396	2·324	2·202	2·327	2·381	2·379	2·363	2·336	2·394	2·351	1·552	2·353	2·522
November	2·360	2·402	2·400	2·411	2·423	2·401	2·354	2·485	2·373	2·454	2·375	2·414	2·434	2·419	2·896	2·429	1·795
Dec. to 20th ...	2·379	2·155	2·100	2·380	2·410	2·388	2·335	2·489	2·449	2·298	2·443	2·428	2·473	2·448	2·595	2·439	1·105
Totals	24·668	25·335	24·305	25·560	25·615	25·400	22·135	26·530	24·677	26·443	25·970	25·938	26·049	26·185	26·649	26·372	40·812
Ratios, 1869 ...	93	96	92	97	97	96	84	100	93	100	98	98	98	99		100	
,, 1868 ...	94	97	96	97	97	96	96	100	97	100	96	97	98	98		95	

ELEVATION SERIES, 8 INCHES DIAMETER.

DATE.	On the Ground	House.		Barn.			Post Gauges.		
	Daily. Mat. Ser	Bracket	Centre.	N.W. side.	Top.	S.E. side.	20 feet. 8 inch.	20 feet. 5 inch.	3 feet. 5 inch.
	in.	in.	in.	in.	in.	in.	in.	in.	in.
January	3·387	1·938	1·999	2·772	1·933	2·725	3·089	2·895	3·184
February	2·445	1·611	1·624	2·532	1·690	2·190	2·110	1·970	2·341
March	1·052	·493	·516	1·002	·421	·690	·739	·670	·926
April	1·124	·853	·869	1·160	·868	1·054	1·008	·909	1·118
May	3·373	2·794	3·007	3·280	2·793	3·178	3·153	3·026	3·315
June	1·345	1·303	1·335	1·354	1·263	1·366	1·318	1·282	1·378
July	·778	·685	·613	·860	·813	·873	·790	·724	·719
August	1·321	1·070	1·240	1·246	1·105	1·221	1·264	1·197	1·213
September ...	4·100	3·231	3·351	4·150	3·418	3·845	3·939	3·810	4·166
October	1·623	1·241	1·366	1·616	1·376	1·576	1·533	1·412	1·569
November ...	2·805	1·900	1·341	2·758	2·100	2·469	2·567	2·430	2·360
Dec. to 20th...	2·409	1·581	1·614	2·359	1·711	2·231	2·281	2·220	2·379
,, 20th to 1st	·925	·719	·723	·915	·730	·885	·829	·792	·888
Total to Dec. 20th	25·762	18·700	18·875	25·089	19·491	23·418	23·791	22·545	24·668
Total to Jan. 1	26·687	19·419	19·598	26·004	20·221	24·303	24·620	23·337	25·556

MAGNITUDE SERIES. (Read Monthly.)

Diameter...	On the Ground.			1 ft. above Ground.						
	Fleming's 3 in.	Stevenson's.	Crallen's 5 in.	1 in.	2 in.	3 in.	4 in.	Jagga Rao's 4 in.	5 in.	5 in. flange.
	in.	in.	in.	in.	in.	in.	in	in.	in.	in.
January..	3·480	3·530	3·551	2·976	2·999	3·214	3·114	3·239	3·145	3·236
February	2·490	1·970	2·546	2·117	2·301	2·416	2·404	2·232	2·308	2·485
March ...	·955	1·075	·984	·605	·723	1·038	1·051	1·030	1·020	1·038
April ...	1·090	·983	1·195	·958	·993	1·113	1·192	1·106	1·116	1·138
May	3·020	3·106	3·392	3·130	3·274	3·055	3·435	3·255	3·188	3·397
June.....	1·227	1·366	1·444	1·365	1·382	1·388	1·448	1·387	1·463	1·485
July.....	·588	·660	·897	·574	·588	·593	·697	·723	·538	·720
August...	1·200	1·158	1·320	1·110	1·210	1·200	1·339	1·234	1·204	1·379
Sept. ...	4·211	3·799	4·277	3·989	4·001	4·211	4·131	4·198	4·100	4·249
October..	1·820	2·213	1·552	2·354	2·289	2·095	2·338	2·216	2·337	2·415
Nov.....	1·895	2·283	2·896	2·429	2·364	2·180	2·413	2·291	2·315	2·375
Dec. to 20	2·416	2·622	2·595	2·787	2·861	2·331	2·124	2·423	2·239	2·459
Total to Dec. 20th	24·392	24·765	26·649	24·394	24·985	24·834	25·686	25·334	24·973	26·376

MAGNITUDE SERIES—(*continued.*)

Diameter..	1 FT. ABOVE GROUND.									
			8 in. flange.							
	6 in.	8 in.	A	B	C	D read daily.	12 in.	24 in.	5 in. square.	10 in. square.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
January..	3·195	3·235	3·300	3·387	3·253	3·387	3·200	3·247	3·181	3·170
February	2·362	2·344	2·382	2·315	2·382	2·445	2·316	2·345	2·225	2·188
March ...	1·103	1·010	·999	1·058	·956	1·052	1·051	1·044	·918	·834
April.....	1·180	1·082	1·107	1·162	1·115	1·124	1·108	1·120	·956	·826
May.....	3·433	3·394	3·343	3·394	3·295	3·373	3·273	3·223	3·236	2·481
June.....	1·426	1·328	1·408	1·459	1·448	1·345	1·462	1·568	1·311	1·180
July.....	·764	·592	·701	·751	·695	·778	·710	·601	·572	·429
August..	1·307	1·221	1·227	1·230	1·213	1·321	1·219	1·217	1·197	1·199
Sept. ...	4·200	4·090	4·112	4·201	4·097	4·100	4·376	4·400	4·000	4·115
October..	2·323	2·220	2·234	2·314	2·262	1·623	2·278	2·240	2·254	2·105
Nov	2·398	2·295	2·309	2·389	2·347	2·805	2·353	2·354	2·329	2·189
Dec. to 20	2·419	2·370	2·397	2·418	2·365	2·409	2·360	2·438	2·596	2·419
Total to Dec. 20th	26·110	25·181	25·519	26·078	25·428	25·762	25·706	25·795	24·775	23·135

NOTE ON THE FOREGOING.

[In the forthcoming report of the British Association will be found an anaylsis of the results obtained by Colonel Ward and Mr. Griffith, with the magnitude series of gauges, up to the end of the year 1869. As a supply of copies of this portion of the report has been granted to me for gratuitous distribution among those interested in the subject, I refrain from quoting more than the following lines:—

"It appears that (excluding the gauge 1 in. in diameter, which everywhere collects less *pro rata* than any other,) the gauges while at Calne only differed 5·8 per cent., the largest quantity being recorded by those gauges which were most easily managed, viz., those 5, 6, and 8 ins. in diameter.

"It further appears that at Strathfield Turgiss the agreement has been still closer, all but the 1 in. and 24 in. agreeing within 1½ per cent.

The differences in 1869 are much larger, probably from the causes suggested by Mr. Griffith, but the most singular feature is, that many of them have changed places, *i.e.*, gauges which in 1868 were slightly in excess, are now in defect, and *vice versa*, so that we still find that at Strathfield Turgiss, as at Calne, it is "almost proved that size has no influence except when the gauge is so small you cannot get the water out, or so large that it acts as a refrigerator, and condenses dew for its own measurement."

Mr. Griffith is partly correct with respect to Jagga Rao's gauge; its

receiving area is only 17·13, while it should be 17·33 square ins., but in addition to this, the glass is not quite correct. The error as given in the British Association Report, is about 0·042 per in.; then we have 25·334 the observed reading, + 1·064 in. (the correction) becoming 26·398, which is in excess of all the other gauges, as from the text it is evident Mr. Griffith considered it should have been. This is very satisfactory, as it proves the accuracy of the observations and of the testing (since no especial care was taken in so doing), and also the general trustworthiness of Mr. Griffith's remarks.

And this is one reason why we have not exercised our editorial privilege of expunging the somewhat trenchant criticisms which he has passed on several of the gauges—a pet one of our own included.

As throwing some further light on, and facilitating comparisons of the material series, we have added at the foot of the table of their amounts in 1869, the ratios of the various gauges to the ebonite one for 1868, as well as 1869. They support every statement in Mr. Griffith's report, and perhaps suggest some other reflections. For instance, a few years since there was a great fuss made about evaporation from rain gauges, one person holding a high appointment in this country, declaring it amounted to several inches per annum, and even calmer writers deeming it considerable. While No. VII. in 1868, showed that the total absence of a pipe produced a loss of about 1 per cent., and No. VII. in 1869, with an aperture of half-an-inch in diameter, has lost 12 or 13 per cent.; it is evident that gauges made with ordinary care are free from all suspicion. No. II. is a gauge purposely arranged to defy the sun's power; it is nearly 3 ft. long, 2 ft. being buried in the earth, the case is double, the interstice being filled with a thick layer of felt, the pipe is narrow, and reaches to the bottom of a glass bottle which stands on the bottom of the can, a foot or more below the level of the ground, but this gauge retains no more (if anything a trifle *less**) than the others. While therefore observers must hold No. VII. before their eyes as a warning, they may take No. II. as a reminder that *in media tutissimus.*

While fully concurring in Mr. Griffith's remarks as to the "caution" (rather a mild word), with which the "eccentric" records of roof gauges must be received, we think the following table shows that there is method in their madness, and that in fact their indications take the same form as the Rotherham set which we have already discussed, some easily explained indications to the contrary notwithstanding.

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* Possibly some rain never gets down the pipe.

Elevation Series, Strathfield Turgiss.

Mean daily horizontal motion of air.		Ground.	House.	Barn.			Posts.		
		8 in. diameter. 1 ft. above ground.	8 in. diameter. On bracket. 39 ft. above ground	8 in. diameter. N.W. side. 11 ft. above ground	8 in. diameter. On top. 23 ft. above ground	8 in. diameter. S.E. side. 16 ft. above ground	5 in. diameter. 3 ft. above ground.	8 in. diameter. 20 ft. above ground	5 in diameter. 20 ft. above ground
miles.									
37	Calmest day, Aug. 6th ...	100	87	93	85	90	93	96	88
58	Calm days (10)..	100	88	97	86	92	98	92	89
142	Mean ratio for year	100	73	97	76	91	96	92	87
368	Rough days (10)	100	64	97	61	87	101	93	86
441	Roughest, Feb. 8	100	15	142	32	85	117	78	64

Out of the seven elevated gauges, five show a tolerably progressive decrease in the amount collected, according to the increase in the force of the wind, in fact, agree generally with what was found at Rotherham, but their differences are greater, indicating probably the greater disturbing influence of the buildings on which they are placed, than that of the gauges by themselves on lofty pipes as at Rotherham. The gauge on the N.W. side of the barn on windy days, not only caught *more* than on calm ones, but actually more than that on the ground, but when it is remembered that nearly all the rain at Strathfield Turgiss comes from between S. and W., it is evident that the N.W. side of the barn would catch the rain obliquely, and offer such an obstacle to the wind that an extra amount in that gauge under such circumstances is not surprising. The reversed order of the numbers, with the gauge at 3 ft., is not so easily understood; the only explanation which occurs to me is, that being in the garden (at M in frontispiece to *British Rainfall*, 1868), while the ground gauge was in the magnitude enclosure (at R in same engraving), it is somewhat sheltered by the hedge. Still, as the hedge is not more than 6 ft. high and 30 ft. distant, while the gauge itself is 3 ft. high, its angle of elevation above the mouth of the gauge is only 5°, which seems insufficient to explain the anomaly. I have little doubt that its low reading in August arose from the fact of the can being black, and fully exposed to the sun, while the ground gauge was partially sunk therein, and was white.—ED.]

REMARKS ON THE RAINFALL AMONG THE CUMBERLAND MOUNTAINS FOR 1869, AND ON EVAPORATION.

By Isaac Fletcher, Esq., M.P., F.R.S.

I am glad to be able to report that during the past year all my mountain rain gauges have been regularly attended to, and that they are all in excellent order. I have not the smallest reason for supposing that any of them have been molested or tampered with. Two of the gauges—at Esk Hause and Sprinkling Tarn, suffered from the unparalleled frost of December 27th and 28th, but no escape of water took place in consequence, and they have been carefully repaired. At the end of the year the gauges on Scawfell Pike, Great End, Esk Hause, and at Sprinkling Tarn, were found to contain ice; they were therefore brought down to Wasdale Head, and their contents melted before the fire.

The rainfall of 1869, like that of 1868, is very considerably above the average. "The Stye" still maintains its pre-eminence as the wettest spot in Europe, though the fall for last year is not so great as that of the preceding one, and very considerably less than that of 1866. As pointed out in a previous contribution, I placed a second gauge on January 1st, 1867, on "The Stye" at Taylor's Gill, distant from the old gauge about 300 yards, and at the same height above sea level, and I give below the results from both. The old gauge is somewhat exposed, but the one at Taylor's Gill is excellently concealed.

Year.	The Stye.	Taylor's Gill.	Difference.
1865	149·07	... .	..
1866	224·56	... .	...
1867	184·71	163·70	—21·01
1868	207·49	178·17	—29·32
1869	198·19	179·07	—19·12
Means ...	192·80	173·65	—23·15

The late Dr. Miller obtained these results on the site of the present Stye gauge :—

1850	189·49
1851	169·62
1852	167·73
1853	134·91
Mean	165·44

Dr. Miller fortunately obtained his results in a cycle of dry years,

and on the other hand mine have been got in wet years. A mean of my results and his will probably give a tolerably correct approximation to the average rainfall on The Stye, and on this assumption it is 179·12 inches!

The monthly gauge at Seathwaite is placed side by side with a gauge read daily; the difference between the receipts of the two since both have been in operation is as follows:—

Year.	Read daily.	Read monthly.	Difference.
1865	117·49	106·61	10·88
1866	179·12	166·71	12·41
1867	133·31	115·96	17·35
1868	157·11	138·33	18·78
1869	150·11	133·03	17·08
Means	147·43	132·13	15·30

These figures prove that the monthly gauge receives 11½ per cent. less than the 5 in. Howard read daily. From the structure of the monthly gauge with a considerable water surface and large aperture at the bottom of the funnel, I believe there is from it a considerable, but not very great, evaporation, but the chief cause of the difference between the two gauges arises from the funnel being frequently choked with snow and hail. But from whatever causes it may arise, those causes will no doubt operate to the diminution of the true amount of rainfall in all the other mountain gauges, to *at least* an equivalent per-centage, and assuming this to be so, which I believe I am fully justified in doing, 11½ per cent. should be added to the amount of water actually measured in each mountain gauge. Applying this correction to the receipts of The Stye gauge for the last five years, we have the following startling figures:—

Year.	Correction.	True Rainfall.
1865	+17·14	=166·21
1866	+25·82	=250·38
1867	+21·24	=205·95
1868	+23·86	=231·35
1869	+22·79	=220·98
Means	+22·17	=214·97

As all the other mountain gauges are more liable than the one at Seathwaite to the diminishing influences which I have enumerated, from the greater prevalence of high winds, snow and hail, I feel sure that to arrive at a better approximation than we have hitherto done, an additive correction of at least 11½ per cent. must be made to the receipts of all my mountain gauges read monthly. It seems highly probable that the average annual fall on The Stye would, if measured daily, amount to no less than from 200 to 210 inches. I append the

monthly fall for last year at the five stations where the largest quantities have been measured.

Month.	Seathwaite.		Sprinkling Tarn.	Stychead Tarn.	Taylor's Gill.	The Stye.
	daily.	monthly.				
January	17·43	15·57	17·35	18·07	21·20	25·09
February..... ...	23·13	22·04	ice 7·83	13·30	24·48	30·68
March	3·21	3·00	froz.	3·93	4·18	3·25
April	10·26	8·14	22·60	10·26	13·05	14·67
May	3·16	2·80	3·34	3·33	3·20	3·39
June	5·13	5·17	5·28	5·60	5·68	5·94
July...	8·30	8·50	8·98	8·44	12·84	13·14
August	4·51	3·35	4·49	5·42	5·97	6·09
September	24·09	21·51	20·42	20·55	27·15	31·27
October	9·95	8·40	9·45	11·94	14·77	15·87
November	23·19	20·14	froz.	ice14·16	ice19·80	ice21·80
December	17·75	14·41	27·21	18·70	26 75	27·00
Totals	150·11	133·03	126·95	133·70	179·07	198·19

I am glad to find that the difficult subject of evaporation is likely to claim more attention in future than it has hitherto done. In *British Rainfall* for 1867, I described the form of apparatus which I have used, and though not insensible to its defects, I adhere to the opinion that the results I have obtained give a better approximation to the *absolute* amount of evaporation than any which have hitherto been published. For the reasons I then stated it appears that the observations of Mr. Luke Howard, which were made with a *covered* vessel, and the more elaborate observations of Dr. Miller, which were made in an open vessel exposed to wind and sunshine, but placed under a shed during rain and at night, must give results far below the true amount, though no doubt relatively correct. On rare occasions half-an-inch of water has been evaporated from my gauge, and I have found by experiment that during very hot weather, and during prolonged drought, when the atmosphere is very dry, the daily evaporation from Bassenthwaite Lake was ·45 inches for ten consecutive days. The mention of Bassenthwaite reminds me of a curious anecdote related to me by an intelligent old gentleman who has lived on the margin of the lake all his life. He says, that an old man, long dead, on whom he could fully rely, once informed him that the lowest and highest points at which he had ever seen the level of the lake, occurred *in the same* 24 *hours*, and within that period the water rose vertically $10\frac{1}{2}$ feet! What a pity there was no rain gauge in Borrowdale in those days!

With the apparatus I have described, Dr. Miller found from uninterrupted daily observation for twelve years an average yearly evapora-

tion of 29·664 in. at Whitehaven, whilst Mr. Howard's observations in the neighbourhood of London gave 20 inches only. It will be seen from the following table how greatly my six year's observations are in excess of the results obtained by the two eminent meteorologists I have alluded to.

Evaporation at Tarnbank for the six years ending with 1869.

Month.	1864	1865	1866	1867	1868	1869	
January...	1·227	1·617	2·949	·874	1·257	1·950	
February	1·760	1·247	2·213	2·107	2·932	1·890	
March	2·591	3·234	2·719	3·397	2·718	3·718	
April	4·751	5·218	5·736	4·226	4·378	5·527	
May	6·105	6·271	7·372	6·852	6·711	5·649	
June	5·449	7·364	6·406	6·278	7·333	6·270	
July	6·230	7·228	6·496	6·247	8·109	7·009	
August	5·581	5·200	4·753	5·639	6·630	5·606	
September.. ...	4·194	4·174	3·871	4·764	4·198	3·003	
October.....	3·159	2·872	2·400	2·793	2·835	2·184	
November.....	1·698	1·691	2·518	1·824	1·424	2·681	
December.....	1·504	1·919	2·116	1·334	1·895	1·251	
Total Evap..	44·229	48·035	49·549	46·335	50·420	46·738	Mean...47·551
Rainfall.....	41·525	39·276	50·790	36·782	46·150	47·069	,, 43·599

The evaporation and rain gauges stand side by side, are each 5 ft. above ground, the former having an aperture of 8 in. and the latter of 10 in. The general conclusion to which I have arrived at is, that at Tarnbank the average rainfall and evaporation may each be set down at between 46 and 47 in.

Though I have ventured the opinion that my experiments on evaporation give more reliable results than any which have yet been published, I am very far from regarding them as absolutely correct, and the difficulties which lay in the way of the construction of a *perfect* evaporation gauge appear to me insurmountable. Mr. Symons has suggested a cylinder long enough to contain two-thirds the annual rainfall, buried in the ground, with the opening 1 foot above it. This I believe has been tried, and no doubt will give *relative* results with tolerable accuracy, but as the surface of the water will receive no sunshine and but little wind, it cannot be any guide to the actual amount of evaporation. Being buried in the moist ground at a frequently lower temperature than the atmosphere, there will, I think, be considerable condensation within the tube.

It is well known that evaporation goes on freely from ice; thus in eleven consecutive days of frost during the present month, ·360 in. were evaporated from the frozen contents of the gauge, or an average of ·033 in. per day.

ISAAC FLETCHER.

Tarnbank, Cumberland, January 25th, 1870.

RAIN GAUGE EXPERIMENTS AT ALDERSHOT CAMP, HAMPSHIRE.

By Colour-Sergeant J. Arnold, A.H.C., F.M.S.

Lat. 51° 15′ 25″ N. Lon. 0° 45′ 36″ W. Height above Sea, 325 ft.

For the Year 1869.

Height above ground ...	6 in.	3 ft.	6 ft.		12 ft.	25 ft.	30 ft.	Deficiency in upper inclined gauge.
Diameter of Funnel ...	8 in.	5 in.	5 in.	5 in. tilted at 45°	5 in.	8 in.	5 in. tilted at 45°	
	in.	in.	in.	in.	in.	in.	in.	in.
January	3·46	3·35	3·23	5·56	2·91	1·93	5·41	—·15
February	3·23	3·12	2·96	4·52	2·68	2·19	4·54	+·02
March	1·22	1·21	1·15	2·09	·98	·65	2·14	+·05
April	1·36	1·33	1·30	1·80	1·28	·92	1·63	—·17
May	4·57	4·44	4·35	5·70	4·14	3·50	5·82	+·12
June	1·38	1·33	1·28	1·47	1·25	1·07	1·50	+·03
July	1·06	1·03	·99	1·47	·99	·98	1·49	+·02
August	1·20	1·15	1·10	1·43	1·04	·92	1·44	+·01
September ...	3·65	3·54	3·36	5·78	3·14	2·53	5·73	—·05
October	2·38	2·30	2·20	2·93	2·09	1·89	3·06	+·13
November ...	2·19	2·11	2·06	3·08	1·93	1·54	3·04	—·04
December ...	3·47	3·33	3·24	5·76	3·00	2·25	5·75	—·01
Totals	29·17	28·24	27·22	41·59	25·43	20·37	41·55	—·04

[Having only just received the above table from Mr. Arnold, I am not prepared to offer any lengthy remarks upon it, but in erecting two gauges, similarly inclined, at the altitudes of 6 ft. and 30 ft. respectively, he has stolen a march upon other experimenters, and the remarkably close agreement of these gauges (0·04 in.) in spite of their different elevation, which with horizontal mouthed gauges would involve a deficiency of nearly 7 in. in the upper one, suggests a host of questions which further experiments must answer.—Ed.]

ROYAL OBSERVATORY, GREENWICH.

Lat. 51° 28′ 38″ N. Long. 0° 0′ 0″

Amount of Rain collected in different gauges in each month of the year 1869.

1869	MONTHLY AMOUNT OF RAIN COLLECTED IN EACH GAUGE.							
	Cylinder partly sunk in the ground read mntly	Cylinder partly sunk in the ground. read daily.	Crosley's.	On the roof of the Photographic thermometer stand.	On the roof of the Library.	On the roof of the Octagon Room.	Second Gauge at Osler's Anemometer.	Self-registering Gauge at Osler's ‡ Anemomtr
	in.	in.	in.	in.	in.	in.	in.	in.
Jan. ...	...	2·92	2·38	2·32	1·31	1·69	1·25	1·36
Feb. ...	2·50	2·34	2·33	2·24	1·76	1·76	1·22	1·25
March	1·51	1·41	1·36	1·35	1·12	0·74	0·31	0·30
April..	0·95	1·01	1·03	0·98	0·80	0·81	0·54	0·57
May ...	3·48	3·43	3·27	3·39	3·15	2·80	2·47	2·38
June...	1·20	1·15	1·14	1·13	1·06	0·99	0·78	0·80
July ...	0·51	0·55	0·56	0·60	0·57	0·53	0·47	0·43
Aug. ...	1·22	1·21	1·21	1·16	0·86	1·05	0·79	0·83
Sept ...	3·10	3·08	2·97	3·02	2·20	2·49	2·01	2·07
Oct. ...	1·81	1·77	1·70	1·72	1·38	1·66	1·22	1·23
Nov ...	2·40	2·38	2·14	2·30	2·09	2·12	1·84	1·75
Dec. ...	2·80	2·77	2·53	2·65	2·01	2·17	1·75	1·74
Sums..	...	24·02	22·62	22·86	18·31	18·81	14·65	14·71

The heights of the receiving surfaces are as follows :

	Above the mean level of the Sea.			Above the Ground.		
	ft.	in.		ft.	in.	
The two gauges at Osler's Anemometer	205	6	...	50	8	
Gauge on the roof of the Octagon Room	193	2½	...	38	4½	
Gauge on the roof of the Library	177	2	...	22	4	
Gauge on the roof of the Photographic Thermometer Shed	164	10	...	10	0	
Crosley's Gauge	156	6	...	1	8	
The two Cylinder Gauges, partly sunk in the ground ...	155	3	...	0	5	

JAMES GLAISHER, F.R.S.

‡ Recorded on Osler's sheets.

ON THE RAINFALL OF CERTAIN DISTRICTS.

ISLES OF SCILLY. WALES.
DARTMOOR. ON THE BORDERS.
CUMBERLAND. ROSS-SHIRE AND SKYE.

ISLES OF SCILLY.

PART of England, yet not in England, part of Cornwall, but separated therefrom by 25 miles of lively sea, lies a submerged Dartmoor, whose granitic "Tors," rising above the waves, form the well-known Isles of Scilly. Although, of course, our present purpose is to consider the rainfall of these islands, a few words as to their general characteristics will not be out of place.

Their sizes are very different, and their number varies according to the definition of the word "island"; if every rock which is permanently above high-water mark is to be counted an island, there are probably nearly a hundred; if the Orcadian definition "Island—a piece of land, sufficiently large to feed one sheep, wholly surrounded by water," is adopted, I suppose the number would be about a dozen; only five are inhabited. The largest is St. Mary's, which is about 3 miles by 3 miles, and the next largest is Tresco, lying about 3 miles N.N.W. of St. Mary's. Most of the islands, from their small extent, give one the idea of being more lofty than they really are, the highest point being only 150 ft. The wind sweeps over them with great force, but on the other hand, they rarely have any frost, and consequently an almost endless variety of tropical plants flourish in the open air.

The first observations of rainfall in these islands were made at Hugh Town, the capital of St. Mary's, in part of the years 1841, 1842, and 1843, which indicate a mean annual fall of about 35 ins.

The next set (at the suggestion of Mr. Whitley, of Truro) were commenced by Mr. Moyle, at Hugh Town, in 1855, and continued until the end of 1862. His gauge was 11 ins. diameter, about 1 ft. above the ground, and 20 ft. above sea level. The total amount collected in each year is given in the following table :—

Rainfall in the Isles of Scilly, 1856 *to* 1869.

Year.	St. Mary's Hugh Town.	Tresco. Tresco Abbey.			
		Upper Gardens.		Lower Gardens.	
		Large gauge.	Small gauge.	Old gauge.	New gauge.
	in.	in.	in.	in.	in.
1856	29·71	.....	.....	.....	.....
1857	29·22	.....	.....	.....	.....
1858	30·53	.....	.....	.....	.....
1859	30·73	33·88	.....	34·11	.....
1860	33·20	37·32	38·03	37·40	.....
1861	27·53	28·75	29·24	29·36	.....
1862	31·17	36·23	36·30	36·37	.....
1863	24·13	27·42	26·86	27·53	.....
1864	.....	26·91	26·22	27·33	.....
1865	.....	39·61	38·91	41·00	39·83
1866	.....	.....	.....	.....	.....
1867	.....	27·34	.....	28·81	.....
1868	.....	27·40	.....	29·12	.....
1869	.....	28·05	.....	30·05	.....
Means	29·53	31·29	32·59	32·11	39·83
,, 1859–63	29·35	32·72	.....	32·95	.....
,, 1860–65	.....	32·71	32·59	33·17	.....

In the year 1858 several gauges were started by Mr. Augustus Smith, in the grounds of Tresco Abbey, and their results are given in the last columns of the above table.

From the commencement of 1870 observations at Hugh Town have been resumed by Mr. Moyle, with a perfectly accurate gauge of the best construction.

It is much to be desired that the rainfall should be observed in each of the isles, and I waited upon Mr. Smith, the lessee of the islands, at Tresco, in order to obtain his assistance in the matter, but so far as I am aware, no observations have been commenced except those by Mr. Moyle at Hugh Town, as already mentioned.

Under these circumstances, it is as well to make the best of the observations we have, assuming all the gauges to have been correct. We have often shown how closely the mean of the six years, 1860—65, agrees with the mean of a long series of years. There is no long series in Scilly, and the three nearest stations to it where the requisite materials exist, are Helstone, Truro, and Bodmin, and of these, Truro alone reaches back to 1840. The decennial period, 1840—49, is generally very near the true mean of half-a-century, and that for 1850—59 is generally 5 per cent. below it.

Period.	Amount in.	Probable True Mean. in.	Mean 1860-65. in.	Diff. from probable True Mean. in.
Truro ...1840-49	43·81	43·81	42·56	—1·25
,, ...1850-59	40·00	42·00	42·56	+ ·56
Helston..1850-59	36·22	38·03	38·05	+ ·02
Bodmin..1850-59	43·48	45·65	46·12	+ ·47

Here we find, in this extreme S.W. corner of England, remarkable conformity to the rules which were deduced from observations in the midland and northern counties, and ample proof, that in assuming the fall during 1860—65 to represent the mean of a long series of years, our error will be far less than that due to instrumental errors. Reference to the table of rainfall in Scilly, will show that two of Mr. Smith's gauges were at work during this period, and that they showed respectively 32·71 and 33·17. The mean of which, 32·94, is therefore the computed true rainfall at Tresco. It will also be seen that during five years, 1859—63, observations were made simultaneously at Tresco and St. Mary's, and singularly enough, we also find that at Tresco the mean of the five years, 1859—63, is almost identical with that of the six years 1860—65, and consequently we arrive, without further calculation, at the probable true mean fall at St. Mary's as 29·35, and at Tresco as 32·94 ins., say 29½ and 33 ins. respectively.

I know of no reason for this difference, and am inclined to attribute it mainly to instrumental errors; it is, however, very desirable that the uncertainty should be removed by simultaneous and careful observation, with tested instruments.

DARTMOOR.

THERE is no county, the rainfall statistics of which have been more ably discussed than Devonshire. The names of able men who have done more or less for it, crowd upon the mind, from Dr. Huxham's *De aëre et mortuis*, published more than a century since, down to Mr. Pengelly, who has recently issued some elaborate analyses of the returns annually given in this volume. By far the most masterly paper of the series is that by Mr. Storks Eaton, in the *Proceedings of the Meteorological Society for* 1861, Table III. in which paper we specially notice as a type of how rainfall observations should be worked up, and also for the convenience of those who wish to study the subject in detail. We intend merely to notice briefly the progress of rainfall observations in the county, and especially in that portion of it known as Dartmoor, which is thus well sketched by Mr. Eaton :—

"The great granite boss which goes under this name, and from which, with the exception of the Exe, the principal rivers of the county take their rise, extends

about 22 miles from north to south, and varies in breadth from 18 miles in the north, to about 9 in the south. To the north of the Moor, Yes Tor rises to a height of 2,050 ft. ; it is nearly equalled by several of the adjoining hills ; in the south the higher eminences range from 1,400 to 1,800 ft. The average elevation of this wild but healthy district exceeds 1,200 ft. ; it is almost entirely covered with irreclaimable bog, and bare rocks called 'Tors,' and in every direction rapid streams are met with, which are very liable to sudden floods."

This description partly explains the paucity of rainfall observations on the moor. Land which is irreclaimable, or nearly so, is not likely to possess a population either numerous or highly educated, and in such circumstances, considerable expenditure of time, care, and money is necessary, to secure regular and trustworthy records. Even now, only two roads traverse this lofty plateau, and until the beginning of the present century, there was scarcely a house from Walkhampton on the S.W., to Moreton Hampstead in the N.E. In 1808, the Government decided that the centre of this moor would be a safe place in which to keep prisoners of war, and accordingly Dartmoor Prison was built in 1808, at a cost of £127,000. Around this establishment the village of Prince Town arose, and there rainfall observations on Dartmoor were commenced by Mr. Windeatt, of Tavistock, in 1838, the gauge being placed in the garden of the "Duchy Hotel," at an altitude of about 1,400 ft. ; they were continued with more or less interruption for four years, and indicate a mean annual fall of between 50 and 60 ins.

The next set were taken by the Rev. T. Hullah, at Holne Vicarage, which is marked 33 on the map (a new gauge being now at work there), on the eastern edge of the moor, 3 miles W. of Ashburton. The gauge was a 5-in. Howard's bottle, its orifice 1 ft. above the ground, and little more than 650 ft. above the level of the sea. The amounts collected were :—

	Inches.	
1851.....	77·92	} Mean 69·81 inches.
1852.....	102·53	
1853.....	72·83	
1854.....	50·67	
1855.....	48·30	
1856.....	66·60	

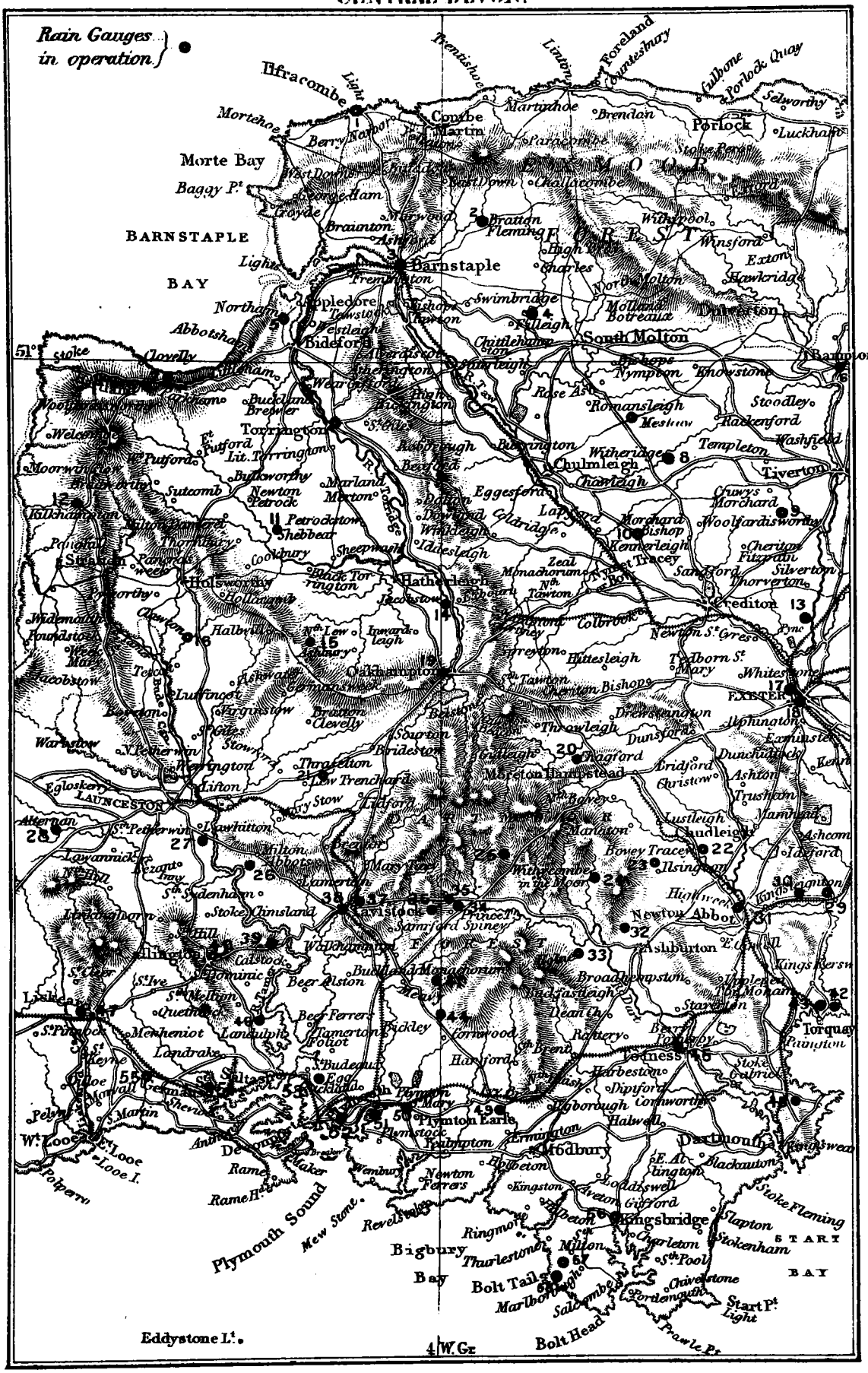
The erection of the gauge next to be noticed was a retrograde step, for which happily we know not who is responsible. Square rain gauge funnels are not good, rain gauges on roofs are desperately deceptive, those on ridges of roofs worst of all, and all these evils are aggravated by elevation above ground and by wind. A singular proof of a perverse determination to go wrong is afforded by the fact that a square gauge was planted in 1853 on the ridge of a part of the prison

roof, nearly 40 ft. above the level of the ground. Its indications are given in the first column of the following table. The second and third columns contain the results of the erection by Mr. Treby (with the assistance of the Hon. Capt. Best, then Deputy Governor), of two 5 in. Howard bottle gauges, one at the Prison Reservoir (34), and the other on the summit of North Hessary Tor (36), at about 1,600 ft. above sea level, and about 200 ft. above the Prison Reservoir gauge.

Position	Prison Roof.	Prison Reservoir. No. 34.	N. Hessary Tor. No. 36.	Morley Clay Works. No. 44.
Above ground	40 ft.	2 in.	2 in.	2 in.
Above Sea ...	1380 ft.	1400 ft.	1596 ft.	.....
1854.....	41·94	.....	.....	.....
1855.....	38·17	.....	.....	.....
1856.....	50·65	.....	.....	.....
1857.....	43·99	.....	.....	.....
1858.....	45·14	.....	.....	.....
1859	49·95	.....	.....	.....
1860.....	63·88	.....	.....	.....
1861.....	45·31	.....	... ..	62·53
1862	57·41	98·51	92·32	74·57
1863...	Imperfect.	82·14	84·38	63·55
1864.....		56·26	59·36	47·22
1865.....		77·43	(75·18)	69·43
1866	Given up.	94·66	94·18	76·05
1867..		79·78	(76·71)	69·08
1868.....		77·65	84·30	67·54
1869.....		75·00	.....	61·27
Averages.....	48·49	80·18	80·92	65·69

Having computed the monthly relation of the roof gauge to the ground one during the greater part of 3 years, when they were simultaneously recorded, it appears that, wide as is the difference, it is very fairly constant for similar seasons, and that the yearly fall on the roof was about 58 per cent. of that on the ground. Thence we find the true fall to be not 48½ inches, the absurd quantity shown by the gauge, but about 80 or 85 inches, which, remembering that this period includes the wet year 1860, agrees very well with the present gauges at the Reservoir (34) and on North Hessary Tor (36). In the last column of the table the amount collected at Morley Clay Works, Lee Moor (44), is given. The average here is considerably lower, because it is on the western side and slope of the moor, scarcely half the height of North Hessary Tor, and with no considerable elevations to the W. or S.W. of it. At the same time it is a most valuable sentinel, 5 miles south of Prince Town.

CENTRAL DEVON.



During 1862 a gauge was kept at Hawson, two miles S.E. of Buckfastleigh, and on the S.E. edge of the moor, and it indicated a very similar fall to that at Lee Moor.

In the same year a gauge was started at Chagford (20), on the northern skirt of the moor, and it has been regularly observed up to the present time. Most unfortunately it was made by an amateur, and on testing it in August last it was found to show on an average about 9 per cent. too much, even after applying a subtractive correction which had been supplied shortly after its erection. Reducing its readings in the ratio 109-100, the mean is about 50 inches, but this value is very uncertain. Mr. Berry procured a new glass, specially adapted for his gauge, last autumn, and henceforward his returns will doubtless be perfectly correct, and we need hardly add very valuable, there being no observer within several miles of Chagford.

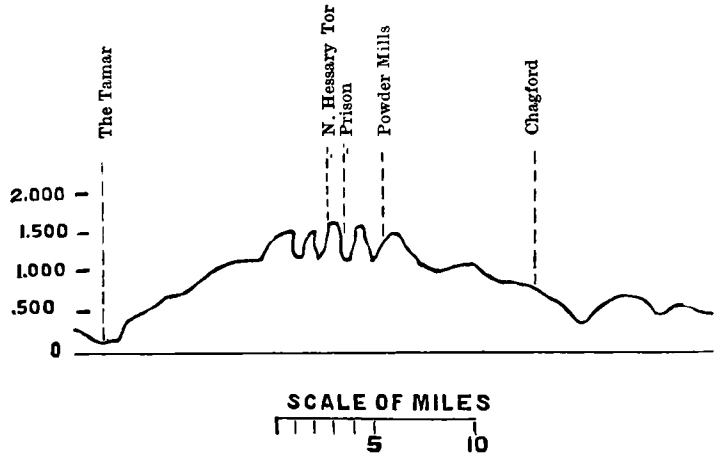
Having thus epitomised and made the most of the observations hitherto taken, I proceed to state briefly the arrangements adopted for securing an extended and improved system. And in the forefront I desire to express my own dissatisfaction with what I have been able to do. I am dissatisfied, because I feel that a gauge ought to be started at the head of the Avon, between Fox Tor and Holne Ridge, and another near Cranmere Pool, 8 miles N. of Prince Town; but though I tried hard last autumn to induce some one to undertake them, my efforts were then unsuccessful, and I left the moor, repulsed, but, I hope, not beaten. That it is not a very nice neighbourhood in winter, may be inferred from the description in Black's *Guide to Devonshire*, which runs as follows :—

"Cranmere Pool lies in the heart of a dangerous morass, 2 miles west of Watern Tor, and is remarkable only from the mystery with which it has been invested by the Devonshire peasants, who have long protested no mortal could ever approach it. It is about 4 acres in extent, and apparently provided with a very scanty supply of water, and a superabundance of black mud. On its western boundary rises the spring of the West Ockment.

Difficulties of this sort have always hitherto been surmounted in Cumberland, in Wales, and in Scotland, and I have yet to learn that the Devonians will be the first to give in, when the desirability of the object is brought under their notice, as it is by the most cursory view of the map. If the Devonshire Scientific Association, through their energetic rainfall representative, Mr. Pengelly, F.R.S., will take the matter up, no one will rejoice more, or more highly appreciate their success, than one who has tried, and has failed.

Though thwarted by Fox Tor and Cranmere Pool, very considerable improvement was effected in other respects, of which the following is

a summary:—A new gauge started at Oaklands, Oakhampton (19), on the northern edge of the moor; that at Chagford (on the N.E. edge) corrected; a new gauge started at Widdecombe on the moor (24); new gauges started at Holne Vicarage (33) (where Mr. Hullah observed, as already noticed); and another just off the moor, at Druid House, by Ashburton (32). Off the moor, on the south-eastern side, a new gauge was started at Totness (45), (where no observations have ever been made), and a recently established one was discovered at Ivybridge. Having examined the Lee Moor gauge in 1863, and knowing it to be in good order, it was not revisited. A gauge was discovered near Sheepstor (41), on the S W. edge of the moor, rather more among the hills than one kept at Burrator in the same parish, between 1855 and 1858. Lastly, another gauge was discovered (*i.e.*, it had been at work unknown to me), a few miles off the N.W. edge of the moor, at Coryton Lew Down (21). Having thus perambulated the skirt of the moor, from N. through E. and S., to W. and N. again, I proceed to notice the gauges along a line running nearly S.W. to N.E., from the Tamar to Crediton. Its section would be somewhat thus:—



Starting from the gauge at Pentillie Castle (46), on the banks of the Tamar, there is a gradual rise to that at North Hessary Tor (1,596 ft.), then a fall of 200 ft. to the Prison reservoir gauge, then a few undulations until about one-third of the distance from the Prison towards Chagford has been traversed, when we come to a new gauge at the Powder Works (25), at an elevation of about 1,000 ft., and then we have nothing till we leave the moor at Chagford, already mentioned. In addition to these, two other new gauges have been started, one at Rundlestone, a mile or two N. of Prince Town, and another is placed

in the Prison garden as a check upon the reservoir gauge, which is becoming rather too much sheltered by bushes.

CUMBERLAND.

The able paper with which we have been favoured by Mr. Fletcher, and which has been inserted on a previous page (36), renders it superfluous to add anything concerning the Western Lake District, except to express our full concurrence in Mr. Fletcher's views as to the correction applicable to all his mountain gauges, and to point out some facts which tend to corroborate them.

It will be remembered that in the garden at Seathwaite, there have been for three years past, three gauges (1), the old one, 5 ins. diameter, started by Dr. Miller 25 years ago, and which has been read daily ever since. (2.) One of the 4 in. diameter mountain gauges, identical with those employed by Mr. Fletcher at all his mountain stations, and like them read *monthly*. (3.) One of the 8 in. float gauges, of which a dozen or so were erected by myself in the Eastern Lake District in 1866, and which like them is read *monthly*. During the last three years these gauges have registered as follows :—

Year.	Amount.			Ratio.		
	Miller. 5 in. daily.	Fletcher. 4 in. monthly.	Symons. 8 in. monthly.	Miller. 5 in. daily.	Fletcher. 4 in. monthly.	Symons. 8 in. monthly.
	in.	in.	in.			
1867.....	133·31	115·96	122·50	100	87	92
1868.....	157·11	138·33	142·50	100	88	91
1869.....	150·11	133·03	140·00	100	89	93

Hence we find that it is not size that produces the differences, and there is little doubt that Mr. Fletcher's explanation is correct. In corroboration thereof we may quote a recent remark by the Seathwaite observer—"*A great many hailstorms when the float catches more than the smaller one.*" It will be noticed that while the deficiency by the 4 in. gauge is about 12 per cent., that by the 8 in. is only 8 per cent. The 8 in. float gauges were designed for districts of very heavy fall (they will hold 48 ins.), and consequently there is a very large internal surface to be wetted, and hence I believe the greater part of their loss, which is of course in the inverse ratio of the amount of rainfall. This is supported (assuming the 8 in. gauge to be in perfect order) by the extreme discordance in the two gauges at Sharrow Bay, a dry spot on

the eastern shore of Ullswater. There are two gauges there, one a 5 in. Casella's can, read daily, the other an 8 in. float, similar to the one we are now considering. The totals for 1869 are, 5 in. 59·29, and 8 in. 40·47, *i.e.*, the 8 in. one caught only 68 per cent., or a trifle over two-thirds of what the 5 in. one did. But the rainfall there proves remarkably small, in six out of the last twelve months, the amount was under 2 ins., in three months under 1 in., and in these cases there would hardly be water enough to raise the float, and we can therefore readily understand its discordant readings, although we must acknowledge astonishment at their extent.

In designing gauges for monthly records, it is only possible to strike a middle path between known sources of error; the larger the inlet pipe to the gauge, the greater the evaporation, *but* the more correctly will you collect snow and hail; the greater the capacity of the gauge, the less correctly will you measure small amounts, *but* the more safe will you be from having your record spoiled by the gauge running over. (In Cumberland you often have more than 30 ins. in a month in the winter, and under 2 ins. in the spring.)

It will be remembered that last year we devoted a considerable space to the elucidation of the irregular distribution of rain in the Eastern Lake District, during 1868; bearing in mind the difficulty of satisfactorily explaining those anomalies, we considered it eminently desirable that the gauges should be continued in operation for some time longer. The returns for 1869 confirm the wisdom of this decision, for last year the gauges on hill sides were in excess, whereas in 1868 it was those at the heads of the valleys, and in 1867 those in the extreme N. and E. of the district that were so. Nothing is at present known as to the cause of these variations, and evidently the only chance of ascertaining it lies in continuing the observations for some years longer.

The return from Mr. Balme's gauge at Elterwater is most unfortunately imperfect, but on the other hand, we are indebted to him for a *daily* record at Brigg Howes, Great Langdale, the return from which seems further to support Mr. Fletcher's views, as to the correction applicable *in these mountain districts*, to the records of gauges taken monthly.

The observations at Kirkstone Pass were interrupted in 1868 by a change of observer. During 1869 a 5 in. gauge was read *daily* at that station (the highest inhabited house in England, 1,500 ft. above the sea), 97·27 in. being collected, and during 1870, an 8 in. float gauge will also be observed *monthly*. There have been a few unim-

portant, but rather complicated alterations at Ambleside, consequent upon the death of Dr. Davy, F.R.S., and the removal of Mr. Wilson from Low Nook. Mr. Wilson transferred his gauge to Mr. Grier, of the Nurseries, who has had it regularly observed; the Rev. S. Joy has placed Dr. Davy's gauge in the grounds of Low Nook, and is observing it there; and lastly, Mr. Jones has removed to Dr. Davy's residence, Lesketh Howe, and is observing there with the gauge he formerly had at Rydal. With these slight exceptions, the arrangements continue precisely as hitherto.

Outside the district represented in the map, several new gauges have been started. On the east there is Crosby Ravensworth, mentioned last year, on the south there are Churchtown Crosthwaite, and Matson's Grounds, Windermere, and on the west there is Waterend, Loweswater.

WALES.

The gauges established by Mr. Bateman in central Wales, in 1866, were continued by him up to the close of 1868, and then removed. Different interpretations having been put upon their indications, it was resolved by the Rainfall Committee of the British Association, that they should be reinstated; this was carried out last autumn, and all six are now in regular operation.

Major Mathew, to whom we are indebted for almost all that we know of the rainfall in the Snowdonian district, has obtained two or three new stations for the current year, but he has had the ranks of his observers sadly thinned by deaths and removals. Knowing as we do how fully, nay, more than fully, his time is occupied, we have not asked, cannot ask him, to beat up for rainfall recruits, especially as he still has more stations under his supervision than any other private observer in the three kingdoms. We heartily thank him for what he has done, is doing, and what we hope he will be able to continue to do, but we cannot ask him to increase his efforts. But we shall surely not be misinterpreted, if we say that, much as Major Mathew has done (and we yield to none in appreciation thereof), there is yet much to do. His staff of observers are most zealous and, we believe, careful, and are collecting much valuable information, but they cannot be ubiquitous, and several important districts are now without representatives. Is Bangor such an uneducated place that no observer can be found there? What is the fall immediately under the lee of Snowdon? A score of fresh stations could be advantageously started, but we want observers, time and attention to start them properly, and money for the instruments.

ON THE BORDERS.

The causes which have rendered observations so scarce on Dartmoor and in parts of Wales, have had the like effect on the wild uplands which separate England from Scotland. We rejoice, however, to state that the Tyneside Naturalists' Club have not only stormed the border, but have crossed it; and further, that Mr. Buchan, the talented secretary of the Scottish Meteorological Society, has gone forth to meet them, and planted a series of new gauges, of which the positions are shown on the accompanying map.

The new stations of the Tyneside Club are mostly along the line of the Border Counties Railway, from Bellingham, in Northumberland, to Riccarton Junction, in Roxburghshire, viz., Falstone, Plashetts, Kielder, Saughtree, and Riccarton. Kielder is within two or three miles of the old station of Deadwater, so long an isolated out-post, just to the S. of Peel Fell. The erection of this line of gauges running from S.E. to N.W. of Deadwater, will increase the value of the Deadwater returns, quite as much as the long period of the Deadwater gauge will benefit the new stations.

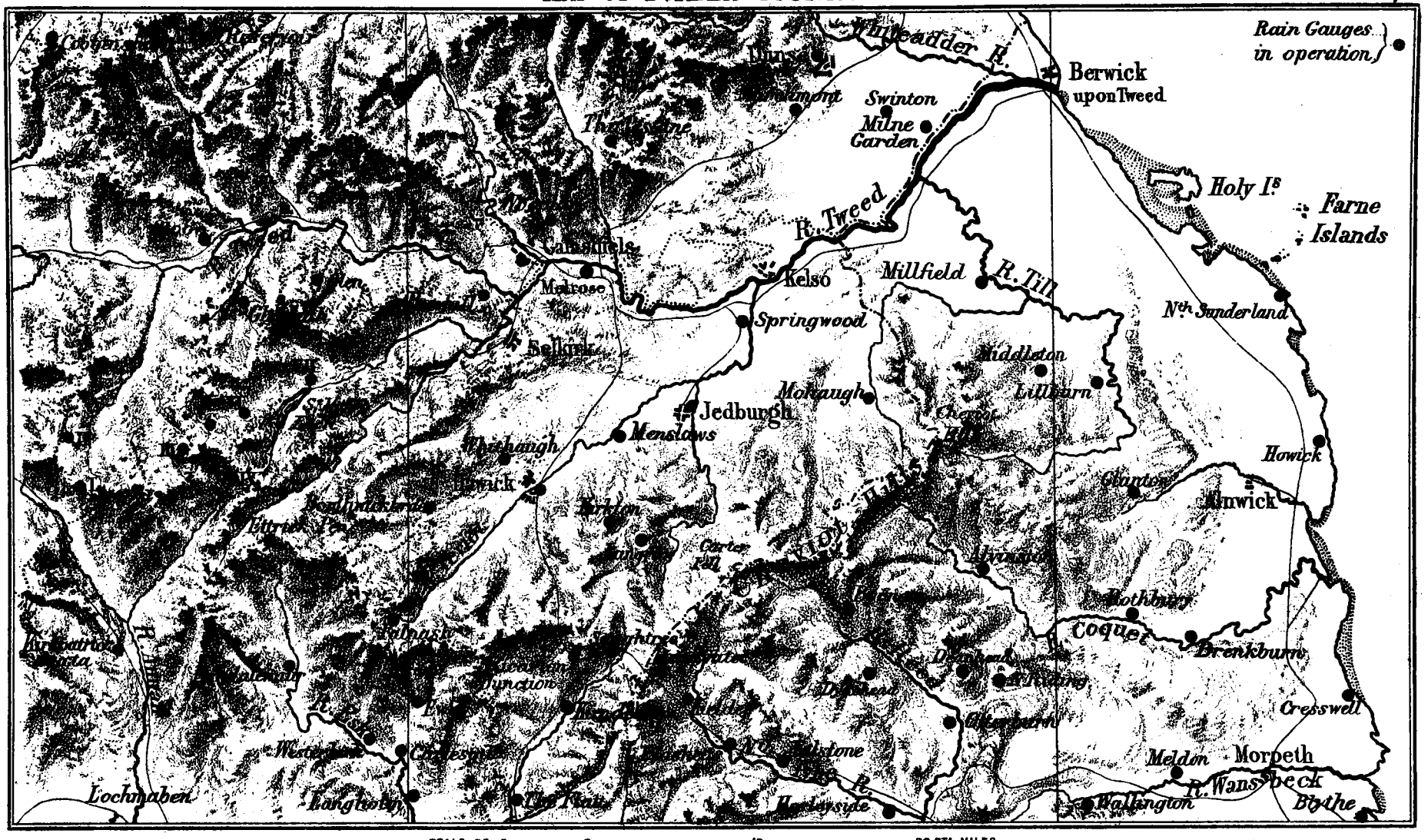
The Club have also started several other stations—Dykehead, North Riding, and Deanhead—the positions of which will be best seen from the map, and others are in contemplation.

The Scottish border-land has long been far better provided with stations, and only two or three new ones have been started on that side of the borders. The important addition to the south-eastern stations of Scotland, is the erection of a set of gauges at the heads of the Tweed and the Yarrow. Their position is shown on the map by Roman numerals, representing the following localities :—

No.	Name of Station.	Height above Ground. ft	in.	Sea. ft.
I.	Tweedshaws	0	8	1,400
II.	Glenbreck	0	8	1,000
III.	Talla Linn Foot	0	8	990
IV.	Kerrcleugh	0	8	1,500
V.	Meggethead	0	8	1,750
VI.	Craigerig	0	8	920
VII.	Dryhope Haugh, St. Mary's Loch	0	8	820

They have been erected by the direction of the Edinburgh and District Water Trust, with a view to ascertaining the relative water supply of certain districts, the actual spots being agreed upon by Mr. J. M. Gale, C.E., and Mr. Buchan. Another gauge has been started in proximity to these at the head of Manor Water, close to the ruins

MAP OF BORDER COUNTIES.



of Macbeth's Castle, at a place marked on the map as Glenrath. Swinton Manse, near Berwick,is also a new station, and so is Melrose.

A general view of the district shows that the points which still require to be occupied are—(1) the flank of Cheviot Hill, (2) close to the north and south side of Carter Fell (Carter Fell Inn would be useful, but the proper position would be two or three miles E.N.E. thereof), (3) on the hills N.E. of Peebles, (4) on the Lammermuir Hills.

The addition of these few gauges, and careful maintenance of those already started, will render it possible to give a very good account of the rainfall in the Border Districts.

ROSS-SHIRE AND SKYE.

The W., and especially the N.W. of Scotland is next to Ireland, the part of the country of the rainfall of which least is known. Where so few observations have been made, and even those few (owing to the amount of sea spray blowing about) are liable to great suspicion, the wisdom of devoting much care to their discussion may to some seem questionable, but if the observations, such as they are, indicate features entirely unlike those of other districts, it is surely our duty to carefully examine whether they bear internal evidence of their truth or falsity.

Most of the *new* gauges which we shall have to mention are in Skye or the adjoining parts of the mainland; we consequently intended originally to restrict this note to Skye, and such parts of the mainland as lay between 57° and 58° N. lat., and more than 5° W. lon. These returns seemed so inexplicable that we added those from the Hebrides, and finally we have had to take a few from Argyll.

The total fall during each year of the last decennial period, as well as the mean for that period are given in Table I. The ratio of each year to the mean of the ten years (for those stations where the period is complete) is given in Table II., and the ratios of the fall in 1861, 1862 and 1863 to that in 1860 (taken as 100) in Table III.

We neither accept, nor do we ask our readers to accept, these returns as correct; they are however the best, and so far as we are aware, the only ones in the district. It is easy to make sweeping assertions, but it is generally difficult to substantiate them. Who is to prescribe the limits within which the rainfall of this district is to vary? In most places in the British Isles it ranges about one-third above, and one-

third below the true mean, that is to say, taking the mean as 100, the driest year would be about 66, and the wettest 132, the fall in the wettest year being twice that in the driest.

Without for a moment asserting it as a rule, it may be mentioned that on several occasions, a very dry period in the S. of England, has been a very wet one in the N.W. of Scotland, and *vice versa*. Now, it is well known that 1860 was a very wet year in the S. of England, in the northern counties it was only slightly above the average, in Ayrshire the fall was actually below it, and so it may have gone on decreasing till we get the North-Western Isles, and come to the (shall we say incredibly small) returns in Table I.

But as to the credibility of these returns; it would be incomparably least trouble to run a pen through all the more extreme sets, and settle them by stating that it was obvious that in those years in which the fall was small, it arose from the violence of the wind preventing the rain getting into the gauge, and in those years in which there is an apparent excess, by declaring that it arose entirely from the large amount of sea spray blown into the gauge. This explanation would do, if (1) the wind which was so extra strong as to blow the rain out, was yet inadequate to raise any sea spray; (2) if it was not the case that several of the wildest registers kept one another in countenance; (3) if we had the slightest knowledge of the limits of deviation from mean annual fall in those districts.

In Table III. we have taken 1860 as a standard of comparison; now assuming it to have been a very dry year in that locality, and that the limits of deviation are the same in this district as in the greater part of England and Wales, it follows from what we have previously stated, that these situations might be expected to have twice that amount in some other year, and therefore all ratios below 200 are clearly reasonable, and not on that ground to be objected to; but what are we to say to 300, 400, and even 600? If these returns had *all* been from lighthouses, or all close together, we might have imagined some "tidal wave" or local flood, had caused the anomaly. If there were only one or two, or if they contradicted one another, careless entries by untrained observers might be advanced as the explanation. But they do not contradict one another, they do not all tell exactly the same story, but they all tell variations of it, and some of the most startling (*e.g.*, Bernera which reports in three successive years 32, 61, and 105 respectively, and Rona, which reports 11, 25, and 52), agree best. Any one who will take the trouble to plot the ratios for Bernera, Oronsay, Rona, and Ushenish, will probably join

us in thinking that if they are wrong, it is most singular that they should have all gone wrong so similarly and simultaneously during ten years.

TABLE I.—*Rainfall in the North-West of Scotland*, 1860-69.

STATION.	1860	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	Mean
SKYE—*Oronsay**	34·40	47·91	67·50	123·81	92·86	46·98	70·23	71·40	97·80	70·70	72·36
Kyleakin	35·52	68·25	68·04	95·10	79·67	79·18	97·58	90·20	125·33	81·80	82·07
Raasay	57·60	86·40	79·20	90·35	69·95	57·25	76·90	67·75	103·25	82·55	77·12
Portree, Prison (Flem.)	87·99	139·04	111·19	148·89	89·54	78·75	97·17	80·57	120·17	...	...
,, ,, (Jagga Rao)	...	...	...	...	...	65·82	88·36	78·75	116·90	...	...
,, ,, (Brit. Ass.)	...	...	...	...	...	...	...	...	108·92	...	...
,, Poor Ho. (,,)	...	...	...	...	...	...	...	...	...	89·30	...
Waternish	...	...	...	...	...	...	91·50	93·55	...	...	...
Rona	10·70	25·10	51·70	65·60	48·40	45·30	38·88	32·05	42·56	34·41	39·47
Uig	...	...	...	..	...	61·79	69·23	67·47	...	...	...
Ross—Inverinate	...	...	...	...	62·30	56·73	74·49	60·72	91·74	69·12	...
Applecross	..	...	...	...	...	55·41	63·93	55·33	71·08	67·69	...
Lochbroom	...	...	...	...	...	38·30	63·07	50·32	65·49	52·83	...
INVERNESS—Inverie	...	...	...	...	...	...	78·00	82·90	112·40	82·60	...
Glen Quoich	...	121·20	...	137·44	92·87	...	...	...	...	84·53	...
SUTHERLAND—Scourie	38·30	50·85	...	...	...	34·60	47·24	...	51·20	52·10	...
HEBRIDES—*Barrahead*	28·44	33·66	34·65	26·73	36·77	35·44	35·61	26·81	31·96	27·19	31·73
Ushenish	12·25	52·77	51·93	55·73	39·95	39·66	49·28	48·43	46·97	42·08	43·91
Monach	...	...	...	...	...	44·10	47·00	44·40	59·20	45·10	...
Loch Maddy	42·65	60·40	69·45	47·35	36·05	26·05	36·40	...	...	49·74	...
Island Glass	25·04	33·63	25·14	23·90	17·51	17·93	30·10	36·16	55·51	46·37	31·13
Stornoway	29·73	39·76	37·23	36·17	29·39	21·41	34·06	25·65	35·49	29·03	31·79
,, (Lewis Castle)	42·80	58·07	53·03	...	41·58	30·38	44·74	28·95	?25·91	22·00	...
Bernera	32·37	60·91	104·95	102·40	84·88	43·30	60·80	48·71	54·90	87·05	68·03
Butt of Lewis	...	...	...	50·94	38·07	38·74	45·40	40·54	48·93	45·65	..
ARGYLL—Castle Toward	47·18	65·34	62·27	57·26	46·85	43·89	63·85	55·03	58·27	45·60	54·55
Inverary	66·40	78·60	63·90	87·20	47·50	40·10	77·00	68·00	81·00	64·00	67·37
Lismore	41·58	45·37	48·39	54·12	52·12	40·11	53·83	46·38	45·98	34·27	46·22
Hynish	88·23	89·57	87·98	87·69	78·42	76·70	78·72	62·56	83·42	66·63	79·99
Ardnamurchan	39·78	53·92	53·04	53·93	46·17	40·78	51·00	37·45	44·01	35·86	45·59

TABLE II.—*Ratio of fall in each year to the mean of ten years.*

Station.	1860.	1861.	1862.	1863	1864.	1865.	1866.	1867.	1868.	1869.
Oronsay	47	66	93	171	128	65	97	99	135	98
Kyleakin	43	83	83	116	97	96	119	110	153	100
Raasay	75	112	103	117	91	74	100	88	134	107
Rona	27	64	131	166	123	115	99	81	108	87
Barrahead	90	106	109	84	116	112	112	85	101	86
Ushenish	29	120	118	127	91	90	112	110	107	96
Island Glass	81	108	81	77	56	58	97	116	179	149
Stornoway	94	125	117	114	93	67	107	81	112	91
Bernera	47	90	152	151	125	64	90	72	81	128
Castle Toward	87	120	114	105	86	81	117	101	107	84
Inverary	99	117	95	129	70	60	114	101	120	95
Lismore	90	98	105	117	113	87	117	100	100	74
Hynish	110	112	110	110	98	96	99	78	104	83
Ardnamurchan	87	119	116	119	101	90	112	82	97	79

* Lighthouse returns have the name in italics.

TABLE III.—*Comparison of Rainfall in* 1860, 1861, 1862, *and* 1863.

Year	I. Glass	Barra.	Scourie	Stornowy	Lewis	Portree	Raasay	L. Maddy	Oronsay	Kyleakin	Bernera	Rona	Ushenish
1860	100	100	100	100	100	100	100	100	100	100	100	100	100
1861	134	118	133	133	136	158	150	142	139	192	188	235	419
1862	100	132	...	125	124	127	138	163	196	191	324	484	412
1863	95	94	...	122	...	169	157	111	360	268	316	613	442

It would occupy an unreasonable space to explain in detail the manner in which the following values have been obtained; they are but first approximations, and the very basis on which they rest is uncertain to 5, if not to 10 per cent. All sorts of corrections have been applied,* and the figures must have no further weight than that due to careful consideration of the records, and all known sources of error. I only insert them as incentives to further and better work in the district, and the sooner they are supplanted by trustworthy values the better will it be. I trust this prefatory caution will not be overlooked.

TABLE IV—*Approximate Mean Rainfall in the North-West of Scotland.*

	inches.		inches.
SKYE—Oronsay	72	INVERNESS—Glen Quoich	111
Kyleakin	82	SUTHERLAND—Scourie	46
Sligachan	145	HEBRIDES—Barrahead	32
Raasay	77	Ushenish	44
Portree Prison	94	Monach	49
,, Moss Bank	92	Loch Maddy	45
Waternish	92	Baleloch	38
Rona	39	Island Glass	31
Uig	72	Stornoway Lighthouse	32
Ross—Inverinate	70	,, Lewis Castle	46
Shiel House	160	Bernera	68
Applecross	64	Galson	35
Lochbroom	54	Butt of Lewis	44
INVERNESS—Inverie	88		

Tremendous as is the range of the above numbers (from 31 ins. at Island Glass, to 160 ins. at Shiel House, Kintail), I do not think they overstate what would be proved by careful observation.

We have already shown by Table II., how very irregular is the secular variation of rainfall in this district; Table IV. shows that its geographical distribution is equally irregular.

It would be all but impossible to write a note on the rainfall of

* As an illustration—at Portree the gauge was originally placed with its orifice only one inch above the ground. On December 5th, 1863, 12·48 in. of rain was registered. The rain on that day was undoubtedly very heavy, probably 4 or 5 inches, and the rain ran along the ground and into the gauge, thus producing the above reading, which is inconsistent with adjacent stations.

Dumbarton and Argyll without constant reference to the valuable assistance rendered by Mr. McDowall; the same to a less extent is true of Ross-shire and Skye, for it was he who obtained the only observations at Shiel House, and the first observations at Sligachan.

The observations at Sligachan and Shiel House have hitherto been extremely fragmentary, but I hope that ere long regular records will be obtained. Few persons can realize the difficulty of getting good observations from such localities, but at last, thanks to great perseverance on the part of Mr. Grant, of Portree, we have an 8 in. Cumberland pattern gauge planted and regularly observed in Glen Sligachan. Several other gauges have been started in the district, as will be seen from the following list of the localities:—

WEST ROSS-SHIRE—School House, Gairloch.
Loch Broom, Braemore House.
,, ,, Lodge.
,, Loch Vraon.
,, ,, Drome.
Loch Carron, Duncraig.
INVERNESS—Skye, Dunvegan.
,, Sligachan.

We hope that all who have any influence in this interesting district, will assist, as far as in them lies, in removing the uncertainties which render this note so unsatisfactory.

Although out of this district, Central Sutherland is not so distant as to make it inappropriate to mention here, the establishment by Mr. Buchan of a new gauge at Lairg. There is hardly any part of Scotland where observations are more needed.

OBITUARY.

THE number of observers whose loss we have to regret during the past year, is somewhat less than in previous years, allowance being made for the increased number of names on our list. But six of them had been observing for upwards of twenty years, three for upwards of thirty years, and two for upwards of forty years, and the loss of such experienced observers, and the termination of such long-continued records, is matter of much regret. A brief notice of Mr. Marshall, of Kendal, was given in 1867, among the list of those to whom we were most indebted for the progress of our knowledge of the rainfall in the Lake District. He died on November 3rd, aged 78, respected not only by his townsmen and the Society of Friends to which he belonged, but also by a large circle of meteorologists, whom he was ever ready to assist. Mr. Thompson, the late observer at Chiswick, deserves mention, not as a meteorologist, to which title we believe he laid no claim, but as a patient, careful, and persevering observer.

	Period of Observation.
Backhouse, W., Esq., St. John's, Wolsingham, Darlington	1864—68 = 5 years
Barham, J. F., Esq., M.D., Exeter and High Week, Newton Bushel, Devon	1840—68 = 29 ,,
Bevins, J., Esq., Thornton, Leicester	1855—68 = 14 ,,
Bland, W., Esq., Hartlip, Sittingbourne	1848—68 = 21 ,,
Box, Rev. H. A., Parker's Well, Exeter	1868 = 1 ,,
Cory, C., Esq., Burgh Castle, and Hopton Hall, Yarmouth	1858—68 = 11 ,,
Eley, G., Esq., Tong, Sittingbourne, Kent	1848—68 = 21 ,,
Gardner, J., Esq., Greenock	1853—68 = 16 ,,
Hassard, M. D., Esq., Glenville, Waterford	1866—68 = 3 ,,
Heap, J., Esq., Royton, Oldham, Lancashire	1836—68 = 33 ,,
Heddle, J. G., Esq., Melsetter, Hoy, Orkney	1863—68 = 6 ,,
Majendie, Rev. H. W., Speen, Newbury	1866—68 = 3 ,,
Marshall, S., Esq., Kendal	1822—68 = 47 ,,
Miller, J., Esq., Isle of Cumbrae, Buteshire	1859—68 = 10 ,,
Sidebottom, J., Esq., jun., Stockport	1866—68 = 3 ,,
Thompson, Mr., Chiswick	1825—68 = 44 ,,
Whiting, Mr., Deepdene, Dorking	1851—68 = 18 ,,

RAINFALL AND METEOROLOGY

OF

1869.

ON THE METEOROLOGY OF 1869,

WITH DETAILS OF THE PRINCIPAL PHENOMENA.

JANUARY.

2nd.—Snowstorm in Yorkshire.

3rd.—S.W. gale with rain; thunderstorm in the S., and lightning in Yorkshire and Durham.

4th.—Heavy rain, which melting the snow in the hilly districts, caused considerable floods. On the morning of the 5th the Usk rose to a greater extent than ever. Floods of considerable volume were also reported on most other rivers, *e.g.*, the Severn, Thames, and Derbyshire Derwent. Several persons drowned while attempting to cross streams.

9th.—A rather smart and singularly local shock of earthquake felt at about 11·17 a.m. (we say about, as observers are not all agreed on the point). It was only felt within a district enclosed by a line drawn from Hadleigh (Suffolk), through Newmarket, Brandon, thence to Watton, and on through Harleston to Hadleigh again.

10th.—Smart earthquake in Bengal. End of the month S.W gales and thunderstorm in southern and midland counties, and serious floods in many parts, especially in Ireland.

FEBRUARY.

During the first week gales prevailed with heavy rain, and many rivers were much flooded. The Irwell, at Manchester, rose 12 ft. above its ordinary level, and many others nearly as much. The wind being from S.W., and Bala Lake very full, the water was driven over the bank at the N.E. end, and the town flooded.

10th.—N.E. gale, with snow, in Durham.

15th.—Slight earthquake in Glamorganshire.

27th.—Thunderstorm at Middlesborough; St. Hilda's parish church set on fire by lightning.

MARCH.

2nd.—Heavy W.N.W. gale on south coast; chimney blown down at Weymouth.

8th.—Shower of snow-crystals in London.

15th.—Between 6.4 and 6.8 p.m., earthquake shock in Southern Lancashire.

16th.—Slight earthquake in East Yorkshire, about 3 p.m.

19th.—Heavy westerly gale in the Channel.

26th.—Heavy N.E. gale, with much snow.

27th.—In the evening heavy thunderstorm; two persons killed by lightning near Whitby.

28th.—High tide on the Ouse, about 50 ft. of the bank gave way near Lynn. Snowstorm in Nottinghamshire.

LIGHTNING IN A MINE.—A strange occurrence is related as having occurred at Carnyorth Mine, St. Just, during an awful thunderstorm. The lightning struck the engine-house, cleaving the spring beam, a balk of timber 9 ins. square, knocking the stair to pieces, with the windows, roof, and stack. The fluid went down the shaft at 50 fathoms, striking H. Boyns in the arm, and rendering H. Lanyon speechless. They thought a gun had been fired at them. On finding the arm not broken, they proceeded up with great difficulty. The lightning went down altogether 300 fathoms, and ran along the tramroad 300 fathoms more, striking R. Angwin in the foot, and W. Tresise in the chest. All the men underground received a severe electric shock. The ozone was suffocating. No death occurred, nor injury to the ironwork of the engine. A man called Archer, working at the stamps engine, was knocked backwards, and the arms of the round buddle machine were knocked away. [To this curious phenomena, related by the *Mining Journal*, we may add that two similar cases have been brought forward by De Fonvielle, in his popular work, *Thunder and Lightning* (p. 172, English ed.), one of which occurred on the 25th May, 1845, at Freyberg, and the other on the 5th July, 1855, in the mines of Himmelsfurth.]

APRIL.

13th.—At Weymouth, from 1 to 4 p.m.. the wind being in the E., there was great refraction on the eastern horizon of the cliffs and ships, one ship having an inverted image of itself standing above it, and above the inverted image, another image of the ship in its proper upright position.

14th.—Destructive thunderstorm in North of England (for details see *Meteorological Magazine*, No. XL).

15th.—Very fine aurora borealis.

23rd.—Earthquakes in Syria and Turkey.

30th.—Several persons killed by lightning in France.

MAY.

5th.—At Ojo Caliente, California, lightning struck a church during service, upwards of 40 persons were killed, either by the lightning or by the shattered ruins of the roof.

10th.—Thunderstorm in afternoon in the Midland Counties, also in Devon, a house struck in Plymouth, and much damaged.

13th.—Fine aurora, seen all over England.

17th, 18th, and 19th.—Destructive thunderstorms all over the country.

31st.—Very fine meteor at 11.3 p.m.

JUNE.

5th.—Smart earthquake in New Zealand.

6th.—Mirage in English Channel; earthquake in Gibraltar, at 5.57 a.m.

9th.—Hurricane at Calcutta.

15th.—Heavy N.N.E. gale on the Durham and East of Scotland coasts; thunderstorm in London; snow on Cumberland hills, and on all the most elevated Scottish mountains.

26th.—Earthquake at Bologna in afternoon, the city clocks stopped and bells rung.

JULY.

5th.—Thunderstorm in vicinity of Bury St. Edmunds.

16th.—Fine meteor at 11.35 p m.

18th.—Thunderstorm on Yorkshire coast; numerous accidents.

26th.—Thunderstorm from Chesterfield to the Tyne.

AUGUST.

15th.—Remarkable clouds of ladybirds came across the English Channel, and settled all over the south-eastern counties.

21st.—Earthquake in the Caucasus, at 8.3 p.m.

24th.—Earthquake in South America, slight at Lima and Callao, but severe at Iquique.

30th.—Earthquake near Melbourne, at 4.45 a.m.

SEPTEMBER.

5th.—Thunderstorm general throughout the country.

8th.—Terrific storm along the Atlantic coast of the New England States.

10th.—Severe thunderstorm in Middlesex and surrounding counties.

11th.—Very destructive gale along the S. coast, and over the N. of France.

15th.—Hurricane to the E. of St. Thomas, West Indies.

17th.—Earthquake at St. Thomas, at 2.50 p.m.

29th.—Heavy thunderstorm in the west-midland counties, lightning remarkably frequent, and hail in places very destructive.

29th.—SELLACK.—Such a thunderstorm as I never before witnessed in England, occurred in the early morning; there was thunder and lightning in the S., and at 7 a.m. we had a thunderstorm here, but merely the margin of a distant one, but from dusk in the evening till after midnight, a series of thunderstorms passed from S.E. to N.N.E. with great rapidity; they were nearest here when at E.N.E., but then so distant that the thunder was only faintly audible. The lightning was most extraordinary, for six hours the flashes averaged from 15 to 80 a minute, some of the flashes exhibited a serpentine form, leaping from S. to N., and often back again, and I noticed many forks which seemed to pass upwards. The lightning seemed to be leaping in all directions, as if rejoicing in its liberty after being pent up during the summer months. There was a steady blue colour in many of the flashes, while occasional reflections which I noticed at a great distance in the N. in another range of clouds were red.

30th.—DUBLIN, FITZWILLIAM SQUARE.—At 8 p.m. a wonderful downpour occurred, soon followed by a vivid flash of lightning, and a long peal of thunder. At 9 p.m. I read the rainfall, it was ·616; of this, at least ·400 fell from 8.5 to 8.20, certainly for part of the time it fell at the rate of nearly ·10 per minute; the water came down in *pipes* so to speak. At 9.15 p.m. the thunderstorm proper began, the lightning was intensely vivid, of a light blue colour, and very beautiful. It was above the lower clouds, and apparently at an altitude of two or three miles, for though the lightning burst just over our heads, the thunder was for the most part distant. From 9 p.m. on September 30th, to 9 a.m. on October 1st, an additional fall of ·630 took place, principally in deluging showers. The total fall for September 30th was 1·246.

OCTOBER.

5th.—Heavy storm in New Hampshire.

11th.—Fine meteor in the evening.

15th.—Heavy floods at Malta.

18th.—Heavy gale on E. coast.
20th to 24th.—Terrific S.E. gale at the Cape of Good Hope.
22nd.—5.50 a.m. slight earthquake at New Brunswick.
30th.—Earthquake at Wiesbaden.
31st.—Earthquake at Darmstadt, at 5 p.m.

NOVEMBER.

1st.—Earthquakes at Darmstadt, at 4.30 a.m. and 11.30 p m.
4th.—Severe thunderstorm in Caithness; Watten Kirk damaged.
14th.—Very heavy gale at Vienna, doing much damage.
27th.—Violent gale in London.

DECEMBER.

12th.—Fine meteor at 6h. 13m. 30s. p.m.
13th and 14th.—Gales and heavy thunderstorm, barometer below 28.00 in the N.W. of Scotland, at 9 p.m.
16th.—Rapid fall of the barometer, in London, at 6 p.m., it was falling 0·150 in. per hour, and a heavy gale all over the country.
19th.—High floods, the Trent, at Nottingham, higher than on any occasion since 1852.
26th to 30th.—Severe frost, temp. falling below 10° in many places.
31st.—Heavy S.W. gale in the southern counties.

RECORD OF EARTHQUAKES, STORMS, &c., 1869.

NORTHAM, BIDEFORD, N. DEVON.

Jan. 3rd.—Lightning in N.E. at 6.30 p.m.
31st.—Tide kept up for two hours on this day, on shores of this parish, when it ought to have ebbed from 7 to 9 a.m.
Feb. 28th.—Thunder during heavy gale from N.W., early morning.
Mar. 9th to 17th.—Aneroid low, without apparent cause. (See Snow and Earthquakes, from Mar. 4th to Mar. 17th.)
17th.—Very low state of aneroid. (See Earthquakes.)
19th.—SUDDEN and strong gale at 4 p.m., from *N.W.*; a large elm blown down in parish, and some barges sunk in the Torridge with loss of life.

IN OTHER PARTS OF THE WORLD.

Jan. 2nd.—10.30 p.m., earthquake in Falkland Islands.
30th.—Earthquake at Bogota, province of Santander.

Mar. 9th.—Earthquake in N. of Scotland.
4th to 11th.—Heavy snow on ground in N. of Scotland.
10th.—Heavy snow and gale at Montreal, Canada.
15th.—Earthquake in Lancashire and Yorkshire.
17th.—Earthquake at Bonn (on Rhine) and in E. Yorkshire.

April 10th.—Warm and close, max. 71°.
11th.—Very warm, max. 76°.
May 17th.—Thunderstorm.
June 8th to 12th.—Clouds and scud without rain.

Sept. 10th.—Very heavy rain from S.; about noon a sudden shift to N.W., with gale, later back to W.; great disturbance probably elsewhere.
11th.—Heavy rain in evening, no wind, glass falling towards night.
12th.—At 2.40 a.m. strong gale from N.W. by W., tree blown down on my premises, schooner lost on bar with all hands.
18th.—·75 of rain fell in 4 hours, from 1.45 p.m.
29th.—Lightning at night.

Nov. 23rd (night) and 24th (morning).—First frost of season, heliotropes cut down.

Dec. 19th.—10.54 a.m., thunder and lightning, gale with squalls.
27th (night) and 28th (morning).—*Greatest cold*, 14°·5 of Fahr.

April 10th.—Curious pillar of fire at Carlisle, from 4 to 5. (? p.m.)
May 16th.—Cyclone at Calcutta.
June 8th.—Cyclone, 12 p.m., on 8th and 9th, at Calcutta, for 16 hours.
26th.—Earthquake at Bologna in afternoon.
July 15th, 16th, and 17th.—Very hot in U.S. America, 100° in shade.
August 5th.—Tornado in Minnesota, U.S.

Sept. 8th and 9th.—Hurricane at Boston, U.S., at night.
26th.—Eruption of Mount Etna, Sicily.
29th.—Tidal wave on Cornish coast, from 6 a.m. to 10 a.m., receding and coming in again.

Oct. 5th, 6th, and 7th.—High tides in America.
10th, 11th, and 12th.—From evening of 10th to night of 12th, hurricane at River Plate, S. America.
20th.—Tremendous gale from S.E. at Cape of Good Hope for 4 days; very heavy rain.
31st.—Earthquake at night, at Mayence, on the Rhine, Darmstadt, &c.

Nov. 1st.—Earthquake at night at Mayence, on the Rhine, Darmstadt, &c.
18th.—Heavy gale on Lakes Erie and Ontario.

Dec. 25th, 26th, 27th, and 28th.—Heavy snow in Spain.
28th.—Earthquake at Santa Maura, Ionian Islands, at dawn of day.

I. H. Gosset.

OBSERVERS' NOTES ON THE YEAR 1869.

I.

HAREFIELD PARK, UXBRIDGE.—Thunder on the 9th of May and 15th of June, and only on those days.

TEDDINGTON.—The heaviest fall of the year on the 27th of November, began from the S.E., and ended from N.W., with a breeze but not a gale of wind; the entire fall was 1·06, ·04 having fallen before 9 a.m. I think it rained 18 hours.

HADAM HOUSE, UPPER CLAPTON.—On 46 days during the past year the rain was acid. The acid reaction when strong could be observed with blue litmus paper, but when weak required a mixture of iodide of potassium and starch for its development. On no single occasion have I been able to detect the presence of peroxide of hydrogen in rain water by any distinctive test, such as chromic acid, or ferrous sulphate and carbolic acid. The water was the more acid as its quantity was smaller, and the time of the previous drought was longer. The snow water of the 25th and 27th of December was strongly acid.

II.

LINTON PARK.—There were 76 frosty days during the year.

BROMLEY COMMON.—Rainfall 1·59 below the average of four years.

BECKENHAM, PARKSIDE.—Several periods of great departure from the average temp., viz., *Above*, from January 3rd to 9th; January 28th to February 11th; April 10th to 14th; July 16th to 18th; August 22nd to 28th (the hottest week in the year); and October 8th to 12th. *Below*, March 3rd, April 5th, May 28th, June 1st, 14th, and 21st, October 17th, 20th, 25th, and 30th, November 3rd, December 5th, 25th, and 29th. Ther. 20 times above 80°, of which three were above 90°. On the whole the year was very nearly of the average temp. As to the rain, the total amount was only slightly above the average; the summer was very dry, for in June, July, and August, only 3·264 in. fell, being 1·418 in. less than in the same three months of 1868,

and only ·844 in. more than in the three driest consecutive months, May, June, and July of that year. Very strong gales for a week in the middle of September, and a week in the middle of December, in both cases between the first quarter and full moon.

Forest Lodge.—The fall of rain at this station was 1·32 above the average of the preceding 13 years. It is perhaps worth remarking, that it fell on 153 days, the precise number on which it was registered in the previous year, while in 1867, ·01 or more fell on 154 days. January, and notably February, were very wet months, March and April drier, and May again wet; the last half of June, and the whole of July were extremely dry—the wells running short; a great deal of rain in September and December. It snowed heavily on the 27th of March. Intense heat prevailed during the drought in July, and during the last half of August. The heaviest fall of rain, though registered (according to rule) on the 9th of September, took place during a thunderstorm, about 6 a.m. on the 10th, 0·83 in. falling in little more than an hour. Very heavy gales characterized the concluding four months of the year; during one tremendous gale from the W., on the 16th December, the bar. reduced read 28·779. The hard frost with which the year appeared about to conclude, changed to rain on the 31st.

Ryde, Isle of Wight.—Rainfall 2·50 in. above the average of eight years.

Cadlands.—During the year the W. wind prevailed on 51 days, S.W. 107, S. 6, S.E. 36, E. 26, N.E. 34, N. 30, and N.W. 73.

Leigh House, Havant.—Average of six years 31·82, being 2·81 more than 1869.

Eastlands, Basingstoke.—Rainfall of the year about an average, the last six months all below 1868, except September, which was 0·60 in. above; only one day, 27th November, on which more than 1·00 fell in 24 hours. Mean temp. of December, 9°·2 above December, 1868.

Wote Street, Basingstoke.—On 23rd of April a severe thunderstorm with floods of rain; 0·35 fell in 35 minutes.

Lynwood.—The heavy fall of rain on the 27th of November occurred with a falling bar. and high temp., without much wind, and was followed at the beginning of December by a great increase of cold and steady, but not high bar. The greatest cold registered on grass was 18°·5 on 28th December.

III.

Broughton, near Banbury.—A remarkable thunderstorm about

6 a.m., September 29th; distant thunder was heard, and a little (·03 in.) rain fell; it then cleared off, but remained sultry all day. At 6 p.m. distant thunder was again heard, and lightning seen in the S.W., from soon after this till about 11 p.m.; the whole atmosphere seemed one blaze of light; there was only a little thunder at times when rain fell. Total rain 0·89 in.; during the greater part of the storm the stars were shining.

Aston Rowant.—1869 the driest for many years past; wells have been dry in the neighbourhood, that I have never known fail before.

Thorpelands, Northampton.—Drought felt severely in July and August, and also in October and November. No extraordinary falls of rain in the year, and springs quite as low in November as in the previous year. A most extraordinary absence of frost in January and February, with a very high temp., so that white turnips continued to grow all through the winter, and got nearly into flower by March.

Abington Pigotts.—The average yearly fall here for seven years (1863—9 inclusive) is 22·432 in., and number of days 148. In 1869, 23·645 in. fell upon 163 days. Frosty nights in 1869: in air 81, and on grass 127.

IV.

High Roding.—Rainfall 0·60 in. above mean of 1866—9; number of days 11 below the average.

Dunmow.—Close of January very mild; spring flowers of every description; beginning of February very high gales from S.W., doing much damage; 1st to middle of March winterly weather, 18th heavy gale; April 7th spring weather, first swallow seen, 19th bar. rose 1 in.; June 5th summer weather began; August 29th great fall in temp., 18° in 24 hours.

Audley End.—Bar. (corrected) mean for year, read twice daily, is 29·954; highest, December 6th, 30·602, lowest, December 16th, 28·885. Mean daily temp. of the earth 6 in. deep, at 9 a.m., 49·31; at 12 in. deep, at 9 p.m., 50°·42; mean max. temp. 55°·97, mean min. 41°·21. Highest in the year 88°·7, on 22nd July, lowest 15°, December 28th.

Drinkstone Park, Bury St. Edmunds.—A very singular supposed shock of earthquake was most distinctly heard and felt in this neighbourhood, at 10 minutes past 11 a.m. on the 9th January.

Geldeston, near Beccles.—The number of large falls is very remarkable, especially that on July 18th (1·64), which fell in about an hour and-a-half. The total of this year (27·63) is the largest I have

registered since I began in 1866, my mean for 1866-67-68 is 22·83 in. So far as I have been able to examine snow measuring, I find that in three instances I have investigated, 1 in. depth of snow = ·06 of water very nearly.

PICKENHAM.—July warm and dry, terrific storm on 8th; a thunderbolt fell 40 yards from the hall door. October stormy, 27th, 28th, and 29th heavy gale and snow, sharp frost on the 26th.

COSSEY.—January 4th, snowdrops in bloom, 20th, elder shoots 1 in. long; February 3rd, crocuses out, 9th, weeping willow in leaf, 15th, rybus and Tartarian honeysuckle in bloom, 20th, hawthorn hedges in leaf; May 28th, gale from N.E.; 216 clipped sheep died from exposure near Ipswich, and many swallows also perished.

V.

PENHILL, SWINDON.—Rainfall 3·77 above the average of last 11 years.

IMBER.—My well is about 90 ft. deep; it was almost dry during the first half of December, the water began to rise in it about the 18th.

LANSDOWN VILLAS, WEYMOUTH.—I think the rainfall here is less than at places a few miles N. or S., for in showery weather, especially with a westerly wind, the rain clouds seem to be attracted to the hills which run from Abbotsbury in the N.N.W., to St. Alban's Head in the E., and to the Isle of Portland in the S., leaving this place dry. The max. temp. here in the shade was 82·1 on 19th July, and the min. 22·8 on the 28th of December; there were 65 nights on which my grass min. fell to 32°.

MELBURY HOUSE.—January 29th, heavy thunderstorm with hail; August 31st, low-lying parts of the park white with frost; November 22nd, early morning wind very loud and blustering, occasionally like thunder; heavy rain in morning.

CHALBURY.—Rain in 1869 (29·29) is 3·96 below the mean of five years, 1865—69, and the number of days on which it fell (163) is also below the average, which is 166.

DEVON AND EXETER INSTITUTION, EXETER.—December 29th, snow 2 ins. deep; this is the only fall for the whole year that would tell upon the rain gauge, and this would only be a fractional amount.

BROADHEMBURY.—A dry year, total fall 29·98, average (30 years) 34·44; the driest year on record is (25·92 in.) 1854.

SPRINGFIELD, TIVERTON.—Between 8 a.m. on 21st of March, and 8 a.m. on 22nd of March, the aneroid fell from 30 in. to 29 in. On

the morning of 26th December there were 3 ins. of snow on the ground, but it all disappeared on the night of the 29th.

GREAT TORRINGTON.—Average rainfall of seven years 40·46, that of 1869 is 1·87 above it; this is less than those of the three previous years, and in excess of the three next preceding; half the annual fall occurred in the last four months, one quarter in the first two, leaving the residue for the other six months. The number of rainy days has again decreased, being only 179, while the average (seven years) is 192. There have been six days on which the fall exceeded an inch, on 10th September, 0·33 fell in 10 minutes, and 0·93 in an hour and a quarter; the fall in September was very heavy after the drought of the previous three months. December was a very wet month; June was drier than last year by 0·25 in. The springs began to fail much earlier in 1869 than in 1868, in consequence, I suppose, of the depth to which the heat had penetrated, so that the large rainfall did not compensate for evaporation or loss. There were only a few thunder-claps. Meteor 9.15 p.m., May 20th; another, 6 p.m., November 6th. The wall trees which were in bloom in February had their fruit destroyed in March by frost; a pear tree was in full bloom in the middle of November. On 13th September, during a heavy gale from the N.W., which was very destructive to the orchards, there must have been a fall of sea-water, as the skins of pears were quite briny to the taste, and in a day or two the foliage looked scorched. This place is full 9 miles from the sea in a straight line. The harvest was very fine, and all got in, in perfect order in about three weeks, without rain.

MESHAW.—Rainfall 38·63, being 3·25 below average of eight years, and lowest but one, 1864, when only 29·49 fell; number of days 196, being 8 above average. Year distinguished by many severe gales, and remarkable variation of bar. Very little thunder during the summer. Highest temp. 82° on 27th August; lowest temp. 15° on 28th December.

MIDDLECOT HOUSE, ILSINGTON.—Notwithstanding the excessive drought last summer (1869), the crops have proved abundant in this very hilly neighbourhood, situated on the borders of Dartmoor, and 700 or 800 feet above sea level. Turnips and mangolds turned out splendidly, whilst they almost failed in the low country. The soil on these hills is very deep in many places, and is easy to till either in wet or dry weather.

CATCHFRENCH.—Terrific gale with thunderstorm on the night of the 12th of September, when 0·72 in. fell. Snow on the 25th December.

BODMIN.—The drought in June, July and August was unexampled.

St. Sennen.—The fall of rain (24·42) is small, especially when compared with Penzance. [Penzance is 39·92. The fact is, this gauge is virtually at the Land's End, and the wind is so tremendous, that the rain cannot get into the funnel of the gauge, or getting in is blown out again.—Ed.]

Dinder.—Notwithstanding the extreme dryness during the summer, more rain fell during the year than in any of the previous five years; the average for six years, 1864—69 is 38·77, in 1869 45·45 fell, being 6·68 above the average.

Mells.—January 28th, very heavy gale and torrents of rain; Feb. 12th, heavy rain and floods; March 19th, heavy gale, torrents of rain; April 9th, swallows in force, 11th, cuckoo, woodpecker tapping, 12th, nightingale, 15th, aurora during much of night, extending from Vega to Capella at 10 p.m., outsides plainly tinged of a ruddy colour; May 12th, white clouds in masses, like broad stripes of auroral rays; August 29th, sudden change of temp., ther. in sun falling 59° and in shade 27°; September 11th, 12th, and 13th strong gales, trees blown down; December 14th tempestuous night, on 16th floods in all directions, 21st snow.

Bath Institution.—The average fall of rain in the Bath district for the previous nine years, viz., from 1860 to 1868, both inclusive, was 28·981. The year 1869 (31·639) shows an increase of 2·708, the number of rainy days shows a decrease, being 161, against an average of 169. The fall of the 27th of November was the heaviest since the commencement of the observations in January, 1865.

VI.

Cirencester.—The year 1869 has been remarkable for great rainfalls in 24 hours, and notwithstanding the large average fall of rain, for a dry summer, was especially propitious for the hay and corn harvests. The average fall for 21 years ending 1864, was 30·00; for 5 years ending in 1869, 35·37, making for the 26 years 31 in.

The Firs, Cirencester (half a mile S.E. of Cirencester).—During 1869 we have had only two thunderstorms. The one on the evening of the 29th of September was of unusual character; it commenced between six and seven in the S.E., and passed over the town of Cirencester towards the N.W.; the thunder was not so loud as it is sometimes, but consisted of one continued roar and glare of lightning for three-quarters of an hour, during which time ·70 of rain fell. The sunsets of 1867-8 were exceedingly beautiful, the whole W. being one glow of crimson, but during the year 1869, little or no crimson has

been seen, excepting on a few days towards the end of December. The appearance in the heavens called "Noah's Ark" has been more frequently observed during 1869 than in any previous year to my knowledge; usually it is seen in October and November, but seldom in any other month. In 1869 it has been visible two or three evenings in the week, from March to the end of the year.

UPFIELD, STROUD.—Highest temp. was on July 17th, 18th and 19th, when, with a N.E. wind, the ther. in the shade, 4 ft. from the ground, marked 87°, 86°, and 87° Towards the end of October the ground was for two days nearly covered with snow. December 27th, 18°.

SAUL LODGE.—The rainfall here in 1869 (30·28) is 6 in. more than the annual average fall of the previous 11 years (24·26). The rain which fell here on the 16th, 17th and 18th of December was 2·88 in., and is larger than I have ever recorded in three consecutive days, the nearest approach to it being in the first four days of September, 1866, when 2·00 fell. The most sudden and extensive fall in bar. pressure, unaccompanied by wind, of which I have any note, occurred here between 8 a.m. and 8 p.m. on the 21st of November; it fell from 30·43 to 29·38, or 1·05 in the 12 hours, and rose again, not with the usual sudden rebound, but quietly during the next three days, and with slight fluctuations continued to rise till the 6th of December, when it reached the rather unusual height of 30·73. During the whole of this period, with the exception of a few showers, the weather was fine and singularly calm. The calm here may be accounted for by the fact that over the British Isles and a great part of Europe this decrease of atmospheric pressure was nearly equal and simultaneous, and therefore not likely to cause much local disturbance.

BOYCE COURT.—Average rainfall for last 4 years, 25·93; 1869, 31·78, or 5·85 above the mean.

ROSS.—Rainfall 6 in. above the average of the last ten years; the largest in one year was in 1852, being just in excess of 1860. The summer months, June, July and August, with least rain since observations commenced in 1852, being only 2·40 against 12 inches in the same period in 1852, and 11·5 in. in 1860, 1864 being the next driest summer, with 2·75 in.

BROOMY HILL, HEREFORD.—The greatest flood of the river Wye at Hereford for several years occurred on December 19th, 1869; this flood was 4 ft. below that of 1795, and 2 ft. 10 in. below the level of the flood of 1852.

STRETTON RECTORY.—The fall this year (30·48) has been the greatest I have recorded during the last 9 years; the least was in 1864, 18·65 in.

LUDLOW, MILL STREET.—The fall of September 30th was the heaviest in the last four years.

WESTON-UNDER-LYZIARD.—Very sudden change of temp. in August: 28th, 88°; 29th, 55°; 31st, 33°.

VII.

STRETTON HOUSE, HINCKLEY.—Average of last four years 26·86, the rainfall has been very unequally distributed over the various months, the fall in May being eight times greater than in July.

BELVOIR CASTLE.—The fall of rain from January to May being unusually heavy, assisted in giving us the longest hay crop known for many years, and a dry July enabled the farmers to secure the crop in excellent condition. In October and November the land was dry, and the germination of corn retarded by the absence of moisture; the heavy rainfall of December again occurred, and assisted to raise the annual average amount, and to give an excess of 4·00 in.

WELBECK.—The rainfall in 1869 was 1·50 in. above the average, the wettest months being May and September; the months of January and February were very mild, with strong S.W. gales, but March was excessively dull and cold, and the early fruit-tree blossoms were much injured; April was fine, but May was the wettest month in the year, with a preponderance of cold E. winds, the cereal crops, therefore, were much backened and injured during its course. The apple crop that looked so well in April, was likewise a failure, the fruit being small and unsaleable. A long dry period set in on the 28th of May, and continued to the 6th of August, the heat being quite tropical at several dates in July. The great fall of rain in May saved the crops from being so much injured by drought as in the summer of 1868, but the weather did not suit the wheat crop, which was generally considered below the average in yield. It has been doubted whether any frost occurs in July and August severe enough to injure vegetation, but this year, on 31st of August, dahlias and potatoes were quite blackened by it.

BRAMPTON.—January temp. 59°·4 on 11th, 22° on 1st and 2nd, hazel in full blow on 16th, snowdrops on 17th, heavy gale on 29th and 30th. Elder in leaf on February 7th, hawthorn buds burst, gooseberry in leaf and primrose in flower on 12th, lime in leaf and wych elm in flower on 14th, willow on 18th; gales on 4th, 24th, and 25th. March a cold month, max. 49° on 5th and 18th, min. 23° on 7th, below 32° on 14 days. Swallows on April 8th, solar halo on 10th and 12th, dog violets on 13th, magnificent aurora on 15th, elm and horse chesnut in leaf on

19th, oak and ash in leaf almost simultaneously on 25th, green leaves of last year on the oak. Orange-tipped butterfly on 7th of June, wheat flowered on July 18th. August 91° on 25th and 28th, 29°·7 on 31st, wheat harvest on 14th, ladybirds abounded on 27th. Splendid lunar rainbow, with secondary bow, on 19th September, aurora on October 6th. Min. 18°·2 on 28th December.

VIII.

WIGAN.—Rainfall in 1869 is 0·17 in. above the average.

BOLTON-LE-MOORS.—Rainfall in 1869, 2·26 in. more than 1868, and 1·82 in. more than the mean of 38 years, ending 31st December, 1868.

SOUTH SHORE, BLACKPOOL.—Average rainfall for 14 years, 30·92 in., in 1869, 32·29, excess 1·37 in. From 15th of June to 24th July no rain, from 24th to 31st July, 0·50.

CATON.—Notwithstanding the dry spring and summer, the rainfall of 1869 exceeds the average of 18 years by 4·17; in the six months, March to August, rain fell on 60 days, amounting to 13·38 in., and in the other six months on 115 days, amounting to 31·52 in.

ALLITHWAITE.—January 30th, tide broke over Brogden's Bank, drowned 170 sheep, and did other damage. February 1st, highest tide washed over *our* bank, but did no damage. March 9th, splendid aurora, 8·45 to 9·15 p.m., four aspects; 1st, a simple arch; 2nd, narrow at each end like breathings; 3rd, Jacob's Ladder, with vibrating steps; 4th, narrow arch nearly through the zenith. June 21st, snow patches on Helwyllyn. July 27th, cows suddenly gave 25 per cent. less milk; drought. August 29th, swallows crowding thick on the window-sills [Query, from cold, as that was a very cold day, following very warm ones.] October 16th, Coniston Fells white with snow. November 29th, snow, sleet, thunder, and beautiful tongues of lightning at 6.30 a.m.

HOLKER, CARTMEL.—Max. temp. on Saturday, the 28th of August, being 90°, min. 28th December, 13°; greatest fall of rain on 13th of November, measuring 1·349 in.; 6 ins. of snow fell on the 26th of December, and 2 ins. on the 29th of December.

ULVERSTONE.—From 11 p.m. of 12th November, to 6 a.m. on 14th, 31 hours, 2·18 in. of rain fell; from 12 p.m. on 17th December, to 8 a.m. on 18th, 1·21 in. fell in 8 hours; the latter occurred after a smart thunderstorm. Bar., uncorrected and reduced, fell to 28·83 during gale on 13th of December.

BROUGHTON HALL.—The usual average of the neighbourhood is, I

believe, about 46 in., the fall here in 1869 has been 6½ in. above this; ·73 fell in 10 hours by night, ·62 in 7 hours by day, on 13th and 14th of November, 2·14 in. in less than 30 hours. The 6 months between February and September, show only 13·51, the remaining 6 months showing 39·14.

IX.

TICKHILL.—Average of ten years, 1860—69 inclusive, 23·98; in 1869, 25·38 in. fell, being 1·41 above the average.

FRIESLAND.—A remarkable fall of rain occurred, commencing on the 17th of December, between 11 p.m. on the 17th, and 7 p.m. on 18th, a period of 20 hours; the amount was 2·56 in., of which 1·60 fell between 11 p.m. on 17th, and 9 a.m. on 18th, *i.e.*, in 10 hours.

RIPON.—Snowstorms on 25th and 27th of December; drifts were, ordinarily 5 or 6, and in some places, 10 or 12 ft. deep.

SEDBERGH.—Snow 7 to 9 ins. deep on 26th December.

HULL, BEVERLEY ROAD.—Average of 11 years = 24·13; 1869, 28·29, or 4·16 in. above the average. A year remarkable for great, sudden, and frequent changes of temp., and many storms.

X.

DURHAM OBSERVATORY.—The great snowstorm of 25th and 26th of December was accompanied by such a high wind that it is impossible to say whether the amount in the gauge is a fair measure of the fall or not, the amount found in the gauge melted was 1·065; the average depth was perhaps 10 ins., but in many places it drifted to 3 feet and upwards.

WALLSEND.—On Christmas day snow began to fall and for two or three following days it fell at intervals until about 8 or 9 ins. deep, a thaw came on about the night of the 29th of December, next day was wet and windy, and by the 31st all snow on the flats was melted; amount of snow and rain for this period was 1·415.

OTTERBURN.—January 3rd, thunderstorm, 5th rainbow, 10th to 14th wind changed daily with the sun; this seldom occurs in winter. Always fine calm weather; 17th thrushes singing. July 20th, thunder, hail, and a beautiful circling waterspout. August 31st, potatoes frosted down to the ground. November 14th, a splendid lunar rainbow.

WHITFIELD RECTORY.—August 28th, hottest day of the year = 76°; on the morning of 31st, ice was found. Min. readings of ther. 31°·5 on

31st. September, remarkably wet month. November 29th, min. 20°, whilst 100 ft. lower level nearer the water it was only 15°. December, only on one night was the ther. above 32°, 27th, the coldest night, 10°; heavy snow storm on 27th, 8 to 10 ins. deep, heavy gale on 13th. Bar. corrected and reduced to sea level down to 28·45.

BRIGG HOWES, GREAT LANGDALE.—In 36 hours, commencing at 9 p.m. on the 12th of November, 10·17 in. of rain fell, that is 4·62, measured on 13th for 12th, and 5·55 measured on 14th for the 13th.

GREAT STRICKLAND.—This year, like 1868, has been divided into two strongly marked periods, the one dry, the other very wet, the result being in both cases that the total rainfall far exceeded the average.

BRAYSTONES.—In the year 1869 the rain at Braystones was 5·12 in. more than in 1868, and 5·19 more than the mean of the previous five years.

SCALEBY HALL.—April 14th, ·53 in two hours during a thunder-storm.

CASTERTON.—January, snowdrops on 10th, furze in flower on 14th, catkins on hazel on 15th, thrush singing frequently before the 12th. February, crocuses on 6th, primroses on 16th, palm on 20th, found two full-grown mushrooms in a meadow on 17th; in about 22 hours, that is, from 7 p.m. on 7th to 4·30 on the 8th, there fell 2·45 of rain. April, cuckoo heard on the 23rd, swallow seen on 19th. Fine aurora on 12th of May. June, fells covered with snow on the 16th. August 28th, hottest day in this year, 86°·5. September, from 4,30 p.m. on the 11th, to following noon, 1·58 in. of rain fell. November, gorse in flower on 3rd, constant rain from 11 p.m. on 12th, to 4 a.m. on 14th, viz., 29 hours, when there fell 2·50 in. December, heavy falls of snow on 26th, with N.N.E. wind, deep drifts, temp. fell to 6° on the morning of 28th.

EASEDALE TARN.—12 in. of snow in February, fine weather in March, April, May and June. Very heavy rain in September; hard frosts and snow in November.

MEASANDBECKS.—June, on the evening of the 15th and morning of 16th, the surrounding hills were covered with snow.

XI.

WALES.

CHEPSTOW (TUTSHILL).—The month of December was the wettest month here since September, 1866.

DINGESTOW.—I am confirmed in my belief expressed last year, that the continuous telegraph wires, and the lightning conductors down every post of the United Kingdom Telegraph Company, prevent accumulations of electricity, and diminish the number of thunderstorms.

SWANSEA.—This year is remarkable for having three days with a rainfall of 1·22, 1·40, and 1·60, respectively. For seven years that we have taken observations, only on three occasions have we exceeded 1·00 in 24 hours. The 1·60 registered 12th of February, all fell between 9 a.m. and 1 p.m.; for the day before I registered ·75, but most of this fell on the early morning of the 12th. I am convinced, that had it been measured, it would have been found that at least 2 ins. fell between the hours of 1 a.m. and 1 p.m. on Friday, the 12th of February.

TEGFYNYDD.—Another very dry summer, and great scarcity of water in many districts. The fall of rain during the month of September was unusually large. A fall of snow early in December, a circumstance not common in this district.

BROOMCLIFF, LLANIDLOES.—From the 14th to the 18th of December, 1869, both inclusive, I registered 5·57 in., being the heaviest rainfall in five consecutive days I ever registered. The flood in the Severn was very high.

BRYN ALYN.—Between October 17th and December 31st, both inclusive, my ther. (Negretti and Zambra) on grass went down to or below 32° on 35 nights; on December 2nd, to 16°; on 3rd, to 17°; on 28th, to 19°; and on 29th, to 19°.

MAES Y DRE.—Average annual fall here about 24·50 (1869, 30·38).

ABERDARON.—The rainfall is 6·79 in. above the average (seven years). The adopted mean. temp. of the year was 50°, being 0°·2 above the average. The following are the adopted mean temps. of every month in 1869:—January, 45°·6; February, 46°·5; March, 40°·9: April, 49°·5; May, 49°·0; June, 53°·9; July, 60°·5; August, 58°·9; September, 56°·5; October, 51°·7; November, 46°·5; December, 40°·8.

BRYMBO.—April 15th, very fine aurora at 10.30 p.m. May 13th, splendid aurora, max. brilliancy about 10.45 p.m., culminating about 10° S. of zenith. Brilliant meteor about 6.50 p.m. on 6th November.

LLWY ONN.—The greatest depth in the year (1·50) on 25th of May, was from thunderstorm; on 3rd of May, ·955 was registered from steady rain without thunder, here at any rate. Rain in 1868, 29·435: in 1869, 31·221; excess 1·786 in.

TREVALYN HALL, ROSSET.—The total rainfall of 1869 exceeds that of

1868 by 0·705; the number of rainy days was 15 in excess of 1868. May, 1869, was a singularly wet month, and June and July were unusually dry. The max. temp. of the year in shade was 89°·2, on July 17th and August 28th; min. temp. was 17°·4 on December 28th.

PLAS BRERETON.—September was remarkable for the heavy falls of rain that occurred on the 8th, ·73; 9th, 1·53; 10th, ·73; 11th, 1·66 (being 4·65 in four consecutive days); 27th, ·83; 28th, 1·10; and 30th, ·65.

ALDERNEY.—The rainfall of 1869 has been 31·59 in., or 2·96 ins. more than the average of the 19 years ending 31st December, 1869, which is 28·63.

SCOTLAND.

XII.

DUMFRIES.—The drought during the spring and summer may be said to have prevailed for six months, from the beginning of March to the end of August, as during that period only 6·90 in. fell. In July and August the pastures were scorched and water very scarce, and notwithstanding the heavy rains of September, many of the springs had not recovered their usual flow in November.

CARLESGILL.—May 29th, potatoes blackened; August 12th, dahlias and potatoes blackened. Temp. April 8th, 20°; August 12th, 30°; December 2nd, 10°; 27th, zero.

KIRKTON.—Average of last eight years 32·20, 1869, 29·60, or 2·60 below the mean.

WOOPLAW.—Smallest yearly amount of rainfall measured here in last ten years.

SPRINGWOOD PARK, KELSO.—The average of the last 16 years here is 24·70; in 1869 22·23 fell, or 2·47 below the mean.

XIII.

THIRLESTANE.—The rainfall at this place in 1869 (24·25) is about 5·25 below the average of the 12 preceding years.

MILLFIELD, HADDINGTON.—The fall in 1869 (19·40) is the least since 1835.

XIV.

NEWTON MEARNS.—We had considerably less than the average yearly rainfall; more than the usual proportion fell at the beginning

and end of the year, as was also the case in 1868. We had a severe drought in summer, and suffered much more from want of water than during the summer of 1868, although we had not such intense heat as in that year. Spring and autumn frosts were more severe than usual. On the morning of the 30th of May potatoes were completely cut over and blackened, and dahlias, Indian cress, and other flowers were just about as badly used.

XV.

ARDDARROCH.—Very dry summer, great scarcity of water along the W. coast. 19th September, bar. fell from 29·20 to 28·70; strong gale from S.W. 13th December, bar. fell from 29·30 to 28·40; strong gale from W.

INVERARY CASTLE.—This has been a very remarkable year, for in February it was so mild that the fields were covered with plenty of green crop, but from that date up to the middle of June, it continued cold, so much so, that on the 10th, 11th, and 12th of June the ther. fell to 26°, with cold N.E. winds prevailing. The weather changed and was fine up to September, when the wet set in, and many cereal crops were injured.

XVI.

LENY, CALLANDER.—April 13th, swallows seen, cuckoo heard on 26th; the max. heat in April was 71°·5; forced all the trees into foliage nearly simultaneously, plane and beech struggling for the precedence with the oak and ash. On 15th of June a slight fall of snow on Ben Ledi (3,000 ft. high); elsewhere on the Grampians snow is said to have fallen to the depth of 3 ft. Up to the end of August a singularly dry and warm summer. The max. heat I registered was 80° in July, and 82° in August.

TRINITY GASK.—The rainfall here in 1869 is under the average.

XVII.

ARNHALL, BRECHIN.—The average fall during the last 24 years, is 34 in.; in 1869 it was 29·40, or 4·60 below the average.

TILLYDESK.—After four months of drought, no less than 5·06 in. fell in 12 days, namely, from the 12th to the 24th of September, and of that quantity 2·149 in. fell in 16 hours on the 12th.

XVIII.

APPLECROSS.—From October 11th to December 1st, inclusive, 52

days, it rained on every day, and from January 27th to February 27th, 31 days, with only one exception.

ARDROSS CASTLE.—This year has been much drier than last; the first five months were very changeable; June, July, and August were very warm and dry. Potatoes killed on the 1st, and snow on the Wyves on the 14th of June. Greatest heat was on the 21st of July, 79°, with frost the same morning. Beautiful aurora on 26th, and scarlet runners killed on the 29th of August. The last three months of the year very stormy, with heavy falls of snow. We had thunder only once throughout the year, that was on the 13th November.

CORRIMONY.—26½ ins. of snow fell in February, March, October, November, and December.

SPANISH, NEAR LOCH MADDY.—The greatest fall of rain taken here was in 1862, 69·45, the least fell in 1865, 26·05; in 1869 the fall was 49·74.

IRELAND.

XX.

CORK INSTITUTION.—January 28th, 30th, and 31st, great floods; these floods were the greatest on record in Cork.

GLENAM, CLONMEL.—The quantity of rain which has fallen in this locality for the last five years, has been almost the same each year, with the exception of 1868, which was 10 ins. under.

BRUCE VILLA, CLONMEL.—It is remarkable that from the 29th of November, 1868, to the 29th of December, 1869, I had not more than ·86 of rain any morning to enter. Very little fog during the year.

XXI.

TULLOGHER.—This station is on an extensive range of hills, very exposed, which will account for an excess of rainfall over other places in the neighbourhood.

BROWN'S HILL, CARLOW.—In September, besides 1·50 on the 30th, there was ·94 on 12th, 1·01 on 17th, and 1·45 on 28th.

FASSAROE.—Return of rainfall for 11 years, showing what fell in the first and last six months of each year:—

Jan. to June.	July to Dec.	Jan. to June.	July to Dec.
1859...18·22	... 21·34	1865...17·61	... 24·60
1860...28·83	... 28·40	1866...22·17	... 16·04
1861...25·67	... 25·32	1867...22·67	... 12·60
1862...24·39	... 21·40	1868...14·59	... 27·12, good harvest.
1863...14·07	... 21·78, good harvest	1869...23·63	... 15·33
1864...11·90	... 19·75		

BLACK ROCK.—In addition to the fall of 1·81 on the 6th of May, there was also 1·70 on the 3rd; I cannot recollect ever registering two such falls so near together. Very hard frost on the night of the 27th of December; my min. was 8°.

DUBLIN (FITZWILLIAM SQ).—Falls of an inch and upwards occurred on three days, viz., May 3rd, 1·320, wind backing from S.E. to E.N.E., upper current S.W.; May 6th, 1·082, wind backing from E. to N.N.E.; September 30th, 1·246, wind backing from E S.E to N.E., upper current S.W. Rainfall in week ending May 8th, 3·059, wind system, N.E. current in Scotland, half of England, and Ireland; S.W. in France and English Channel, trough of low barometric pressure in English Channel. Two long periods of drought, on June 18th to July 23rd, rain ·119 on three days; and August 13th to September 4th, rain ·269, on one day, partial.

XXII.

CREGG PARK.—Summer dry, although 4 in. more of rain fell than the average of the last six years. Harvest very good, little potato blight, mushrooms scarce; the "Polysaccum crassipes," vulgarly called puffs, *very plentiful*, and appeared in circles in the same way and places in which the great crop of edible mushrooms grew last year. May not the puffs be the male plants?

XXIII.

FLORENCE COURT.—We had only one large flood during 1869, this occurred on 29th December, when the rainfall measured nearly 1½ in. The total rainfall has been rather less this year than we have had during the last few years. We have had no severe frosts except on 27th and 28th of December, when the temp. fell to 22° and 20° respectively. The summer months have been colder in 1869 than in 1868.

ANTRIM.—The total rainfall in this district for the years 1868 and 1869 was almost identical. In the former year the registry was 26·58, in the latter 26·66. The months of February, April, September, and November, in 1869, were considerably wetter than the corresponding months of 1868, but less rain fell in March, August, and December. January and February were on the whole very mild months, and June, July, and August bright and agreeable. Gales of considerable force were experienced on the night of January 1st, 2nd, 29th, and 30th; sleet and snow fell on 26th, 27th, and 28th February. Early in October snow appeared, but did not continue. With one exception

(flax) the crops in the North of Ireland were good and abundant in 1869.

SYDENHAM, Co. DOWN.—The rainfall of 1869 is minus that registered in 1868 by 1·98, though the latter year was proverbially *dry* and warm in this neighbourhood; however, this was due to abnormal distribution, the exceedingly slight fall of the summer months, June and July (·52 and ·58 respectively), being more than compensated by immensely heavy downpours in the autumn and winter. The year just closed was characterized by much more equable distribution (if we except September), rain being measured on 216 days, against 199 in 1868.

MONEYDIG.—The first four months of 1869 unusually mild; May and June very cold. The min. of year was on 13th March, when the ther. showed 16° on grass. June too dry for the flax crop; July and August dry and warm. September, from the 11th, had only one dry day, with in many places the greater part of the harvest in the field. November most rainy of any month during six years; December wet.

TEMPLECRONE.—Templecrone is on the extreme W. coast of Donegal, outside all the mountain ranges, and on a *low sea board*, so that frequently rain clouds are seen to pass over without falling here; most probably it will be found that the amount recorded *eastward* of this will be a good deal in excess. [Rev. Dr. Kingsmill, Letterkenny, is the nearest to E. and has 52·86 against 45·86 at Templecrone.—ED.]

MAXIMUM FALLS IN 1869.

NOTHING more surely brings its own reward than hasty generalization, and this general truth is intensified in such a new and difficult branch of research as determining "the whence and the whither," the times and the quantities of the proverbially fickle showers of the British Isles. Thanks, however, to the care and steady perseverance of our numerous observers, it is now in our power to check and confirm by the observations of five subsequent years, the following "hasty generalizations" which we inserted in *British Rainfall*, 1864:—

"One very striking fact becomes clear from this table, which will be best illustrated by classifying the largest falls and the largest per-centages. It will then be seen that though in point of quantity the western stations maintain their excess, as well in individual falls as in the yearly totals, the heavy falls there are relatively hardly half as large as at the eastern stations. In fact, with two or three exceptions, the classification resulting from these falls is a perfect guide to the geographical position of the stations; or to put it in the plainest possible language, the rainfall at the western stations is more uniform than at the eastern ones, where the fall is, so to speak, more spasmodic."

In the first place we give the abstract of the sixteen heaviest falls, and the sixteen largest per-centages, in the same form as in previous years, except that the division of the general tables in which each station is placed, has been inserted for the convenience of those who may not otherwise know the exact localities.

It will be found that with two exceptions (due to the remarkable Aberdeenshire rain of October 16th), all the heaviest falls occurred within 40 miles of the west coast, and not one of the largest per-centages occurred there; *they* are all found at stations on the east coast or in the heart of the country.

ABSTRACT OF MAXIMUM FALLS IN 1869.

Largest Falls.

Date.	Div.	Stations.	Depth.	Per cent.	Fall in year.
Nov. 13 ...	X.	Seathwaite	6·70	4	150 in.
,, 13 ..	,,	Langdale, Brigg Howes	5·55	5	115 ,,
,, 13 ...	,,	High Close, Grasmere	3·81	4	91 ,,
January 17	,,	Kirkstone Pass	3·75	4	97 ,,
Dec. 18 ...	IX.	Whiteholme	3·70	6	57 ,,
Nov. 2.....	XVIII.	Glen Strathfarrer	3·57	6	68 ,,
Feb. 7	X.	Barrow House, Keswick	3·53	4	83 ,,
October 16	XVII.	Tillydesk	3·40	10	35 ,,
Dec. 30 ..	XV.	Camusinas	3·40	4	76 ,,
,, 29 ...	XII.	Wanlochhead	3·19	5	62 ,,
Nov. 13 ...	X.	Middle Fairbank	3·11	4	72 ,,
,, 13 ...	,,	Keswick.....	3·10	4	72 ,,
February 7	,,	The Howe, Windermere	3·10	4	82 ,,
Dec. 30 ...	XII.	Kirkpatrick Juxta	3·05	5	61 ,,
February 7	X.	Ambleside Nurseries	3·00	4	81 ,,
October 16	XVII.	New Byth	2·95	7	41 ,,
		Mean	3·68	5·0	77·7 in.

Largest Per-centages.

Date.	Div.	Stations.	Per cent.	Depth.	Fall in year.
October 16	XVII.	Tillydesk	10	3·40	35 in.
June 15 ...	XVI.	Barry Village	10	2·44	25 ,,
Sept. 12 ..	XIII.	Inveresk	9	1·70	20 ,,
,, 12 ...	,,	Smeaton.....	9	1·53	18 ,,
June 15 ...	,,	North Esk Reservoir	8	2·60	32 ,,
Sept. 18 ...	VII.	Nottingham	8	2·14	28 ,,
June 15 ...	XIII.	Mungo's Walls	8	1·90	25 ,,
Sept. 16 ...	X.	Horsley	8	1·87	23 ,,
,, 18 ...	VII.	Southwell	8	1·87	24 ,,
October 16	XVII.	New Byth	7	2·95	41 ,,
Sept. 12 ...	,,	Inverurie Manse	7	2·50	35 ,,
March 19 ..	II.	Horton Park	7	2·20	31 ,,
October 1 ..	XVI.	Kettins	7	2·10	31 ,,
May 18 ...	VI.	Norton-in-Hales	7	1·88	27 ,,
Sept. 18 ...	VII.	Trent College	7	1·87	26 ,,
Sept. 12 ...	XVI.	Dundee Eastern Necropolis...	7	1·70	25 ,,
		Mean	7·9	2·17	27·9 in.

It is, however, both unnecessary and unwise to rest the defence of our "hasty generalizations" on *one* year when *six* are available. We therefore give the following analysis :—

Analysis of Abstracts of Maximum Falls, 1864 *to* 1869.

Largest Falls.					Largest Per-centages.				
Years.	Depth.	Per Cent.	Mean total fall at these stations.*		Years.	Per Cent.	Depth.	Mean total fall at these stations.*	
			Computed.	Observed.				Computed.	Observed,
	in.		in.	in.			in.	in.	in.
1864 ...	3·47	6·3	55·1	...	1864 ...	9·0	2·48	27·6	...
1865 ...	3·67	6·4	57·3	61·8	1865 ...	9·9	2·62	26·5	28·4
1866 ...	3·40	4·4	77·3	86·2	1866 ...	8·1	2·31	28·5	29·3
1867 ...	3·17	9·0	35·2	42·5	1867 ...	11·0	2·85	25·9	25·3
1868 ...	3·32	6·1	54·3	65·9	1868 ...	8·6	2·55	29 7	30·1
1869 ...	3·68	5·0	73·6	77·7	1869 ...	7·9	2·17	27·5	27·9
Mean ...	3·45	6·1	58·8	66·8	Mean...	9·1	2·49	27·6	28·2

The average yearly fall at the stations having the largest daily amount is 58·8 ins., while at those having the largest per-centages it is 27·6 ins., not half what it is at the first-named group. If this is not sufficient proof of the correctness of our "hasty generalizations," we do not know what would be.

Before quitting the subject, we add another little table, the last column of which shows that for five years, large falls of rain in one day have been becoming more rare. Possibly 1870 may inaugurate a reversal of this tendency. There is no information on the point in an accessible form, and we throw out for the consideration of observers the desirability or otherwise of examining their records and extracting the maximum fall in each year. Supposing (as is very probable) that any regular sequence is negatived, the observations would yet form a most valuable mine of facts for future workers.

Year.	Number of Returns.	Mean Per-centage.	Mean Amount.	Mean Total Fall in year.	1867 being assumed =100.	Ratio of Rainfall to the Mean.	Total Fall being assumed =34 in. Mean Max. =
1865	481	5·1	1·70 in.	33 in.	106	102	5·00 per cent.
1866	590	3·7	1·48 ,,	40 ,,	129	119	4·36 ,,
1867	584	4·6	1·44 ,,	31 ,,	100	100	4·24 ,,
1868	676	4·3	1·43 ,,	33 ,,	106	106	4·21 ,,
1869	637	4·2	1·42 ,,	34 ,,	108	101	4·18 ,,

* In a table somewhat similar to this, which we inserted a few years since, the computed rainfall was alone given; having on the previous page given the observed fall for 1869, we have ascertained it for the four previous years. It will be seen that while in the largest per-centages the observed and computed values agree closely, the latter are considerably in excess in the other group—a result probably due to the wide range of the total falls. We believe the lower values are the more reliable.

THE PRINCIPAL HEAVY RAINS OF 1869.

JANUARY 28TH.

THE fall on this day was one which ordinarily would not call for special notice. The largest amount, although it occurred at a wet station (Ebbw Vale, Monmouth), was only 1·68 in., but small as were the amounts, mostly about 1¼ ins., it was the heaviest fall of the year in parts of Wiltshire, and in Truro and its vicinity. It did not amount to more than 4 per cent. of the yearly total at any station.

FEBRUARY 7TH.

The heaviest fall in the year at the head of Windermere, at Ambleside, Kendal, and detached localities along a line towards Leeds. Being in a wet district, some of the amounts were heavy, for instance, Barrow House, 3·53; The Howe, Windermere, 3·10; Ambleside, 3·00; and the Wood, Windermere, 2·87. It, however, was not a remarkable rain, the largest per centage being only 5.

FEBRUARY 12TH.

At nearly 100 stations this was the wettest day in the year, but it was very local. Almost all the stations having their max. fall on this day are east of the meridian of Greenwich, and between the Thames and the Wash. The exceptions are three or four stations in Rutland and North Leicestershire, and a few on the north coast of Cornwall and the extreme south of Wales. The fall at most stations was 1·10, but in the vicinity of Cambridge it was nearly 1½ ins., though even this did not exceed 6 per cent of the annual total.

MAY 3RD.

A fall of 1 in. or 1½ ins. occurred at several stations in Dorset and North Devon, which in the absence of any really heavy fall during the year, becomes the max. at those stations for 1869.

MAY 25TH.

The rainfall of this day was somewhat more near the ordinary dimensions (if the term may be permitted) of a heavy fall, but even it would not probably have required notice but for the remarkable absence of really heavy falls during 1869. The amounts on this day

were heaviest, both absolutely (1·88 in.) and relatively (7 per cent.), in Shropshire, and the fall extended across the country to the neighbourhood of Hull.

JUNE 15TH.

The northerly gale of this day caused considerable deposition of snow and rain along the east coast from Scarborough to Aberdeen. The amounts increase from one inch in Yorkshire, to two inches in Berwickshire, and nearly three inches somewhat further north, and then gradually decrease to less than an inch in Aberdeenshire. At North Esk reservoir, and at Mungo's Walls, it amounted to 8 per cent., and at Barry village it is reported as 10 per cent. of the annual fall.

SEPTEMBER 11TH.

At most Welsh and Cheshire stations the fall on this day, though small ($1\frac{1}{2}$), was still the greatest on any day in the year.

SEPTEMBER 12TH

In the absence of self-recording instruments it is often very difficult to identify a heavy rain, and so in this case we can simply record a heavy fall in the south-east of Scotland, on September 12th, and leave our readers to decide whether or not it was the shower of the 11th passing onwards to the N.N.E. Possibly this view is confirmed by the heaviest fall of the year occurring in the north of Aberdeenshire, and at several of the Orkney stations on the 13th.

SEPTEMBER 18TH.

The stations at which this was the day of heaviest fall, are with few exceptions between Worcester, Birmingham, and Nottingham; at the latter town the amount reached 2·14, which was 8 per cent. of the total yearly fall. At Southwell it was also 8 per cent., and less at all other stations.

SEPTEMBER 28TH.

A uniform rain of about $1\frac{1}{2}$ ins. over the whole of the southern half of Ireland.

SEPTEMBER 30TH.

The date of heaviest fall in Gloucestershire, Herefordshire, and the south of Shropshire, but by no means a heavy fall, the largest amount (at Reevey Farm) being only 1·87, and the per-centage there (6) being also the largest.

OCTOBER 15TH—16TH.

During the night of the 15th, and the greater part of the 16th, a very heavy rain prevailed over the north of Scotland. It was sharply

defined at its limits; on the south it was bounded by a line running nearly east and west through Taymouth, and on the north by the coast line—very little falling in the Orkneys. At Aberdeen the total fall (part falling into two days) was nearly 4 ins., and several other stations had nearly as much.

NOVEMBER 12TH—13TH.

Heavy rain fell over the Irish Channel, amounts varying from one to two inches being reported from most stations along the Lancashire coast, the north of Ireland, North Wales, the Isle of Man, the south-west of Scotland, and West Cumberland. Among the mountains in the latter county the fall was very considerable and extended over two days, amounting in the aggregate in 48 hours to more than 10 ins., at Seathwaite and in Langdale. The fall began about 9 p m. on the 12th, and during the succeeding 12 hours 4·76 fell at Seathwaite, and 4·62 at Brigg Howes. The fall in the next 24 hours, ending 9 a.m. on 14th (*i.e.*, the rain of 13th) amounted to 6·70 in. at Seathwaite, and at Brigg Howes to 5·55 in.

NOVEMBER 27TH.

This was the heaviest fall in the year at nearly all stations along a belt of country some 30 miles wide, and reaching from the mouth of the Severn to that of the Thames, and having a mean north latitude of about 51½°. The following table gives the amount registered for that day at all stations where the fall thereupon was the max. of the year, and it also gives the per-centage which the fall was of the total for the year.

This table reveals perhaps the most perfect illustration of uniform distribution, and accurate observation ever known. Careful examination of the position of the stations will show that there are four stations, marked by *, entirely isolated from the main body of stations, which had a shower to themselves, and must therefore be dismissed from further consideration. Returning to the others, 67 in all, we find—that the amounts only range from 1·00 in. to 1·78 in.; that more than half of them agree within a tenth of an inch, more than a quarter of them within two hundredths of an inch, and seven stations report exactly the same.

The same remarkable agreement is shown by the per-centages, 43 agreeing exactly, and the remaining 24 only differing 1 per cent., + or —. So much for the returns of those stations at which the fall on this day was the max. for the year.

Depth of Rain on November 27th, at stations where the fall on that day was the greatest on any day in the year.

Div.	Stations.	Depth	Per cent	Div.	Stations.	Depth.	Per cent
I.	Hampton Wick (Fairlight)..	1·01	4	II.	Newbury (Greenham)	1·03	4
,,	Teddington	1·02	4	,,	Maidenhead (Cookham Vic.)	1·32	5
,,	Chiswell Street	1·10	5	,,	,, (The Halls) ...	1·27	5
,,	Camden Square	1·03.	4	,,	Wallingford (The Castle) ...	1·23	5
,,	Islington (St. Mary's Road)	1·02	4	,,	Abingdon	1·03	4
,,	,, (Compton Terrace)	1·03	4	III	Eton	1·30	5
,,	Holloway	1·02	4	,,	Oxford (Radcliffe Observ.)...	1·04	4
,,	Harrow (Station)	1·04	4	IV.	Shoeburyness	1·05	5
,,	,, (Northwick House)	1·03	4	,,	Rochford (Clements Hall)...	1·07	5
,,	Tottenham (Grove House)...	1·01	4	,,	Rayleigh (Hockly)	1·07	4
,,	Mill Hill (Bittacy House)...	1·02	4	,,	Epping	1·00	5
,,	Uxbridge (Harefield Park)...	1·16	4	,,	Dunmow (High Roding) ...	1·00	4
,,	Enfield (Nag Head Lane) ...	1·06	4	,,	Colchester (Birch Hall)... ..	1·02	4
,,	Winchmore Hill	1·04	4	,,	,, Camp	1·02	4
II.	Cobham (Pyports)	1·04	4	V.	Trowbridge (Sunny Side) ...	1·09	4
,,	Wimbledon	1·00	4	,,	Marlborough (Kingsbury St.)	1·17	4
,,	Brixton Hill	1·06	4	,,	,, College	1·15	4
,,	Kew Observatory	1·03	4	,,	,, (Mildenhall) ...	1·18	4
,,	Maidstone (Hunton Court)..	1·00	4	,,	Chippenham (Tytherton) ...	1·11	5
,,	Sevenoaks (River Hill)	1·10	3	,,	*Ivybridge	1·67	4
,,	Bromley Common, S.E.....	1·00	4	,,	*Dartmoor Prison.....	2·21	3
,,	Beckenham (Parkside)	1·05	4	,,	South Molton (Castle Hill).	1·45	3
,,	,, (Foxgrove)	1·03	4	,,	*Callington (Hingston Down)	2·04	3
,,	Deptford (Pumping Station)	1·19	4	,,	Frome (Mells Rectory)	1·21	3
,,	Crossness	1·29	5	,,	West Harptree	1·61	4
,,	Eastbourne	1·04	4	,,	Bath (Paragon)	1·17	4
,,	Lewes (Glynde)	1·04	3	,,	,, (Literary Institute) ..	1·30	4
,,	Basingstoke (Eastlands).....	1·06	3	,,	Batheaston (Bannerdown Ho)	1·23	4
,,	,, (Wote Street)...	1·06	3	,,	Chelvey [Bristol].....	1·17	4
,,	,, (Sherborne St. John)	1·09	4	VI.	Bristol (Montpelier)	1·20	3
,,	Strathfield Turgiss	1·09	4	,,	Clifton (Royal York Cres.)..	1·33	4
,,	Sunningdale (Lynwood) ...	1·35	5	XI.	Cardiff (Pentyrch)	1·78	3
,,	Windsor (Cumberland Lodg.)	1·28	5	,,	Llanelly	1·33	3
,,	,, (Woodside).....	1·22	5	,,	Cardiff (Ely)	1·46	4
,,	Reading (Russell Street) ...	1·25	5	,,	*Tresco Abbey	1·50	5
,,	,, (Englefield)	1·20	5				

In order, however, thoroughly to examine the extent of this shower, we have taken out the amount at *all stations*, as far north as Liverpool, the total number being nearly 500, and from them have deduced the results shown in the accompanying diagram. As it is the first time that anything approaching to the number of returns have been used for examining a single shower, it may be well to explain in some detail the method of its construction, and the information it affords.

All the observations were first entered on a large scale map, the latitude and longitude lines of which were strongly marked; then the average of all the returns in each square was taken, and thus the figures in the various squares of the diagram were obtained. It will be noticed

RAINFALL OF NOVEMBER 27TH, 1869.

	6° Penzance.	5° Plymouth.	4° Exeter.	3° Bath.	2° Oxford.	1° Bedford	0° Wisbeach.	1° The N. Sea.	2°	
										53° 30′
·12	...	·24	·28	·09	·10	·00	·07	...		The N. Sea.
										53°
·43	...	·48	·56	·56	·45	·47	·31	·16		Wisbeach.
										52° 30′
·79	..	·93	·88	·80	·64	·72	·76	·78		Bedford.
										52°
1·00	...	1·08	1·19	·83	1·02	·98	·98	·95		Oxford.
										51° 30′
·94	...	·83	·89	·93	·99	1·05	·99	·91		Bath.
										51°
·81	...	1·09	·91	·62	·53	·77	·94	..		Exeter.
										50° 30′
1·05	1·03	1·15	·98	..	...	...	...	...		Plymouth.
										50°
	1·03	·83	·81	·64	·62	·67	·68	·70		

The above may be regarded as a skeleton map of Wales, and England as far north as Liverpool, on Mercator's projection, and with the coast-line omitted, so as to render the sequence of the numbers as prominent as possible. The dividing lines are all figured, being degrees of longitude, and half degrees of latitude. and a principal town in each line of squares is given, as a further means of identification.

The spaces are of course not equal in area, but may approximately be taken as 45 miles from east to west, and 35 miles from north to south.

The underlined figures at the end of each column show the average fall in the latitude or longitude to which they are opposite.

that these numbers are slightly less than those in the preceding table; this arises from *all* the observations being employed in one case, while in the table, only those are given which were the max. of the year.

As to the results, it is evident that the additional observations support the view of the line of max., running due west and east at a mean lat. of 51½°, and they show us how gradually the shower diminished to nothing in lat. 54°.

Taking the enclosed area at 88,200 square miles (360 × 245), we have an average fall of rain over it of 0·75 in., which gives for the total quantity of water deposited nearly a billion gallons (957,800,000,000), the actual weight of which would be about four thousand million tons. So vast, so inconceivable, is the mechanical force required for a single, and by no means remarkably, heavy shower.

DECEMBER 10TH.

Heavy fall on the west coast of Scotland, about 1½ ins. at most stations, heaviest in Ayrshire, but not exceptionally so even there.

DECEMBER 16TH—17TH.

Two days of steady rain, giving, owing to the absence of any heavier, the max. of the year at several stations in South Wales and in the western counties.

HEAVY FALLS IN SHORT PERIODS.

WINCHMORE HILL.—September 10th, ·44 in., between 5.50 and 6.30 a.m., during a thunderstorm.

HARROW STATION.—October 18th, ·85 in six hours. November 27th, 1·03 fell in 20 hours.

FOREST LODGE.—About 6 a.m., on the 10th of September, ·83 in. fell in little more than an hour during a thunderstorm.

BASINGSTOKE.—On 23rd of April a severe thunderstorm, during which ·35 fell in 35 minutes.

GELDESTON.—From 4.30 p.m. to 6.15 p.m. on 18th July, 1.64 fell during a thunderstorm.

GREAT TORRINGTON.—On 10th of September ·33 fell in 10 minutes, and ·93 in an hour and an quarter.

CIRENCESTER.—September 30th, 0·70 fell in 45 minutes, 1·30 in about an hour, and 2·10 between 4 p.m. and midnight.

SELLACK.—On the 5th of September 0·35 in. fell in six minutes.

ADDERLEY.—1·63 fell between 2.30 p.m. and 8 p.m. May 25th; canal bank burst and meadows inundated near Market Drayton.

WATERLOO ROAD, WOLVERHAMPTON.—Heavy thunderstorm on 25th of May, in the afternoon; 1·50 in. of rain fell in two hours.

ORLETON.—September 30th, 1·28 between 4 p.m. and midnight, during a thunderstorm.

WIGSTON.—April 14th, more than 1·00 fell in less than an hour.

TRENT COLLEGE.—September, between 4.5 p.m. on 18th, and 6 a.m. on 19th, 1·87 fell.

BRAMPTON.—On December 17th, 1 in. of rain fell in 12 hours.

SOUTH SHORE.—September 29th, from 8 p.m., to 8 a.m. on 30th, 12 hours, 1·10 in. of rain, there being thunder from 10 p.m. to 3 a.m. on 30th.

ULVERSTONE.—From 11 p.m. on 12th of November, to 6 a.m. on 14th, 31 hours, 2·18 in. fell. From 12 p.m. on 17th December, to 8 a.m. on 18th, 8 hours, 1·21 fell, after a smart thunderstorm.

FRIESLAND.—Between 11 p.m. on 17th, and 7 p.m. on 18th December, 20 hours, 2·56 fell, of which 1·60 fell between 11 p.m. on 17th, and 9 a.m. on 18th, *i.e.*, 10 hours.

ARNCLIFFE.—2·08 fell on the 18th December, which added to that of the 17th, made 3·20, causing a greater flood than for 40 years.

MIDDLESBOROUGH.—On July 26th, 0·66 in. of rain fell in 15 minutes.

BRIGG HOWES, LANGDALE.—In 36 hours, commencing at 9 p.m. on the 12th of November, 10·17 ins. of rain fell, that is, 4·62 in 12 hours, measured on 13th for 12th, and 5·55 in 24 hours, measured on 14th for 13th.

SEATHWAITE.—11·46 in. fell in 48 hours, *i.e.*, on 13th and 14th of November.

SCALEBY HALL.—April 14th, ·53 fell in two hours, during a thunderstorm.

ABERDEEN.—October 16th, 2·83 fell between 0.0 a.m. and 5 p.m.

TILLYDESK.—After four months of drought, no less than 5·06 in. fell in 12 days, namely, from the 12th to the 24th of September, and of that quantity, 2·149 in. fell in 16 hours on the 12th.

ON THE FALL OF RAIN IN EACH MONTH OF 1869.

JANUARY.

At almost all stations the fall in this month exceeded the mean January fall; the average excess was about 40 per cent. In the centre of England the fall was more than twice the mean, the excess rising to 110 per cent. At stations in the north-west of Scotland the excess was very slight, and some were a trifle under the mean.

FEBRUARY.

The fall in this month was also above the average at nearly every station, the average excess being 100 per cent. In several parts of Wales, Cheshire, Lancashire, and Cumberland, it was more than this, the greatest excess, 150 per cent. was at Llandudno.

MARCH.

This, which is ordinarily a very dry month, was in 1869 exceptionally so, almost all stations having even less than usual. The average deficiency was about 20 per cent., but in parts of Wales, at some stations in Cumberland, and in the south-west of Scotland, the fall was not a quarter of the ordinarily low average.

APRIL.

The fall in this month was very near the mean at all stations.

MAY.

This was a month of consistently unequal distribution. By this term alone does it seem possible succinctly to express the following facts:—In Argyllshire the fall was less than one-fifth of the average; north, south, and east thereof, it rose to half the average at distances of about 100 miles, reached the average at nearly all English stations, and rose gradually further south to twice the average in the Midland counties, and to $2\frac{1}{2}$ times (= an excess of 150 per cent.) in Cornwall.

JUNE.

A dry month, the fall about half the average, in Devonshire and Cornwall scarcely a quarter the average, but at one or two Scotch stations slightly above it.

JULY.

Another dry month, the fall generally about one-third of the average; it was, however, slightly above it at Seathwaite, in Ayrshire, Argyll, and the Orkneys.

AUGUST.

A third consecutive dry month, accompanied by great heat. In every part of the British Isles the fall was below the average.

SEPTEMBER.

The summer drought broke up about the 10th of September, and during the remainder of that month a considerable amount of rain fell, so that the monthly total was about 50 per cent. above the average.

OCTOBER.

A dry month, fall not much more than half the average; in the south of Ireland, and the south-west of Scotland, it was remarkably dry, many stations having less than an inch, in this ordinarily wet month.

NOVEMBER.

In most of the southern parts of England, Wales, and Ireland, this was an average month, if anything rather drier than usual, but in the Northern Counties, in Scotland, and especially in the extreme north thereof it was considerably wetter than usual; in the Orkneys it was, with three exceptions, the wettest November for 28 years.

DECEMBER.

The fall in this month was in most cases above the average, but seldom more than 50 per cent., except in the Eastern counties of England.

MONTHLY RAINFALL IN 1869.

ENGLAND.

County ..	Kent.	Sussex.	Berks.	North-ampton.	Norfolk.	Devon.	Cornwall.	Somerset.	Worcester.
Station ..	Tunbridge.	Chichester.	Newbury.	Welling-borough.	Cossey.	Sidmouth.	St. Austell.	Burnham.	Lark Hill.
Ft. abv. Sea	71	20	235	...	...	26	300	30	157
	in.	in.	in.	in.	in.	in.	in.	in.	in.
January	3·27	2·91	+4·86	2·64	1·68	4·06	+6·35	2·78	4·65
Feb. ..	3·25	1·84	2·54	2·07	2·38	2·06	5·21	2·80	2·70
March..	2·46	1·72	1·48	1 56	3·11	2·09	3·53	1·05	1·37
April ...	1·82	1·06	·88	1·95	1·26	1·09	1·88	1·33	1·26
May ..	+4·04	4·31	3·13	+4·05	2·81	+6·18	5·89	+5·60	5·11
June ...	·98	1·64	1·59	1·29	1·68	·49	— ·48	— ·68	1·23
July ...	— ·15	1·09	— ·50	— ·30	— ·58	·66	·67	·75	— ·30
August.	1·21	— ·59	1·41	·96	1·66	— ·44	·85	1·16	1·34
Sept. ...	3·73	+4·83	4·58	3·01	3·07	2·77	4·60	3·79	+5·33
October.	2·78	2·29	1·39	·94	2·90	1·94	3·15	2·67	1·31
Nov. ...	2·79	1·86	1·37	2·02	2·62	2·11	4·59	1·89	2·21
Dec. ...	3·61	3·21	4·03	3·48	+4·48	3·84	4·65	3·62	3·74
Totals. .	30·09	27·35	27·76	24·27	28·23	27·73	41·85	28·12	30·55

	ENGLAND—(*continued.*)					WALES.			
County....	Lincoln.	Lanca-shire.	York.	York.	Cumber-land.	Cardigan.	Cardigan.	Brecknock.	Merioneth.
Station ..	Branston.	Lancaster.	Leeds.	Whitby.	Alstone.	Kilgerran.	Abery-stwith.	Hay.	Dolgelly.
Ft. abv. Sea	...	118	95	184	1416	80	42	317	43
	in.	in.	in.	in.	in.	in.	in.	in.	in.
January	2·77	5·47	2·21	2·56	6·40	+7·78	5·45	5·28	9·51
Feb. ...	1·90	5·05	2·47	1·22	6·70	5·84	4·25	3·46	7·66
March..	2·54	1·00	1·63	1·51	2·12	1·33	1·93	1·67	3·30
April ...	2·57	2·50	1·46	1·12	1·64	2·72	3·32	1·31	5·64
May ...	+5·12	2·78	+4·42	2·77	2·61	3·68	2·64	5·30	3·29
June ...	1·56	1·95	·64	1·29	·95	— ·42	— ·91	·89	— 1·19
July ...	— ·43	— ·71	— ·44	— ·60	— ·44	·88	1·16	— ·78	2·17
August.	1·55	2·08	1·43	1·85	3·77	·97	3·47	·95	4·44
Sept.....	3·23	+7·60	3·81	1·72	+6·80	7·44	+7·56	+6·47	+11·60
October	1·42	3·58	1·33	2·27	2·40	3·50	4·06	2·31	4·76
Nov. ...	1·61	4·24	1·24	2·77	3·00	4·06	5·30	2·61	8·76
Dec. ...	4·08	4·94	3·70	+4·15	4·75	5·49	3·01	4·44	7·59
Totals..	28·78	41·90	24·78	23·83	41·58	44·11	43·06	35·47	69·91

MONTHLY RAINFALL IN 1869—(*continued.*)

SCOTLAND.

County.... Station ..	Kirkcudbright. Dalbeattie.	Edinburgh. Cobbinshaw.	Dumbarton. Arddaroch.	Argyll. Airds.	Fife. Cupar.	Aberdeen. CastleNewe	Ross. Applecross.	Ross. Ardross Castle.	Inverness. Farraline.
Ft. abv. Sea	25 ?	863	80	15	130	910	50	450	700
	in.	in.	in.	in.	in.	in.	in.	in.	in.
January	7·42	4·10	10·89	6·20	4·48	3·10	5·82	2·83	4·70
Feb. ...	5·99	5·60	10·34	6·70	1·47	1·35	9·08	+5·61	4·80
March..	1·21	1·00	2·74	1·90	1·12	2·23	4·69	2·46	2·00
April ...	2·35	1·40	2·14	3·40	1·46	2·98	3·30	2·13	2·80
May ...	1·87	2·20	— ·57	— ·40	1·01	1·50	— 2·03	2·12	2·80
June ...	1·20	2·20	2·40	2·50	2·58	2·21	2·41	1·49	3·00
July ...	1·95	1·70	2·60	3·30	1·34	— ·50	3·04	1·41	— ·50
August.	— 1·09	— ·90	·97	1·90	— ·73	1·60	4·45	—1·28	·80
Sept. ...	+ 9·32	+6·20	+11·79	9·00	+5·62	3·90	7·24	5·24	4·10
October	1·72	2·20	3·49	4·40	1·84	+5·00	6·17	5·36	+ 5·50
Nov. ...	4·98	4·20	9·70	8·00	·74	2·75	+10·96	4·94	5·30
Dec. ...	7·79	4·10	11·72	+9·10	2·35	2·69	8·50	3·94	5·00
Totals..	46·89	35·80	69·35	56·80	24·74	29·81	67·69	38·81	41·30

IRELAND.

County.... Station ..	Kerry. Killarney.	Tipperary. Clonmel.	Carlow. Carlow.	Dublin. Skerries.	Galway. Cregg Park Gort.	Roscommon. Holywell.	Londonderry. Bellarena.	Cavan. Red Hills.	Antrim. Antrim.
Ft. abv. Sea	20	80	291	12	120	...	20	...	...
	in.	in.	in.	in.	in.	in.	in.	in.	in.
January	6·75	+6·79	5·38	4·15	4·09	3·30	2·52	3·01	2·50
Feb. ...	5·50	3·10	2·66	1·82	3·99	3·23	3·91	+4·23	3·36
March..	3·54	2·59	2·27	3·34	2·84	2·35	1·95	2·88	1·33
April ...	2·75	2·75	2·32	1·84	2·87	2·56	—1·84	2·67	2·55
May ...	3·55	4·29	3·66	3·79	3·97	2·48	1·98	2·88	1·85
June ...	— ·53	— ·69	— ·91	— ·86	1·43	1·09	2·61	—1·06	— ·36
July ...	1·73	2·79	1·60	1·63	1·80	1·54	2·14	1·65	1·97
August.	1·89	1·10	·92	1·12	1·29	1·50	2·16	1·46	1·62
Sept. ...	+13·79	6·05	+7·84	+4·37	+8·24	+6·91	4·03	3·32	3·02
October	3·57	·81	·94	1·23	—1·18	—1·03	2·85	1·38	1·33
Nov. ...	5·90	2·55	2·77	2·23	3·90	2·78	+6·12	3·78	+4·13
Dec. ...	9·97	6·03	4·51	3·54	6·45	4·96	4·62	3·60	2·64
Totals..	59·47	39·54	35·78	29·92	42·05	33·73	36·73	31 92	26·66

MONTHLY PER-CENTAGE OF RAIN IN 1869.

	ENGLAND.													WALES.			
Months.	Tunbridge.	Chichester.	Newbury.	Wellingborough.	Cossey.	Sidmouth.	St Austell.	Burnham.	Lark Hill.	Branston.	Lancaster.	Leeds.	Whitby.	Alston.	Kilgerran.	Aberystwith.	Hay.	Dolgelly.
January ...	11	11	17	11	6	15	15	10	15	10	13	9	11	15	18	12	15	13
February...	11	7	9	9	8	7	12	10	9	7	12	10	5	16	13	10	10	11
March	8	6	5	6	11	7	9	4	5	9	2	6	6	5	3	4	5	5
April	6	4	3	8	5	4	4	5	4	9	6	6	5	4	6	8	4	8
May.....	14	16	11	17	10	22	14	20	17	18	7	18	12	6	8	6	15	5
June	3	6	6	5	6	2	1	2	4	5	5	3	5	2	1	2	2	2
July.....	1	4	2	1	2	2	2	3	1	1	2	2	2	1	2	3	2	3
August ...	4	2	5	4	6	2	2	4	4	5	5	6	8	9	2	8	3	6
September.	12	17	17	13	11	10	11	13	18	11	18	15	7	17	17	18	18	17
October ...	9	8	5	4	10	7	8	9	4	5	8	5	10	6	8	10	7	7
November.	9	7	5	8	9	8	11	7	7	6	10	5	12	7	9	12	7	12
December..	12	12	15	14	16	14	11	13	12	14	12	15	17	12	13	7	12	11

	SCOTLAND.									IRELAND.								
Months.	Dalbeattie.	Cobbinshaw.	Arddarroch.	Airds.	Cupar.	Castle Newe.	Applecross.	Ardross.	Farraline.	Killarney.	Clonmel.	Carlow.	Skerries.	Cregg Park.	Holywell.	Bellarena.	Red Hills.	Antrim.
January ...	16	11	16	11	18	10	9	7	11	11	17	15	14	10	10	7	10	9
February...	13	16	15	12	6	5	13	14	12	9	8	7	6	10	10	11	13	13
March	3	3	4	3	5	8	7	6	5	6	7	6	11	7	7	5	9	5
April	5	4	3	6	6	10	5	6	7	5	7	6	6	7	8	5	8	10
May.....	4	6	1	1	4	5	3	6	7	6	11	10	13	9	7	5	9	7
June	2	6	3	4	10	7	3	4	7	1	2	3	3	3	3	7	3	1
July.....	4	5	4	6	5	2	4	4	1	3	7	4	5	4	5	6	5	7
August ...	2	3	1	3	3	5	7	3	2	3	3	3	4	3	4	6	5	6
September.	20	17	17	16	23	13	11	13	10	23	15	22	15	20	20	11	11	11
October ...	4	6	5	8	8	17	9	14	13	6	2	3	4	3	3	8	4	5
November.	11	12	14	14	3	9	16	13	13	10	6	8	7	9	8	17	12	16
December..	16	11	17	16	9	9	13	10	12	17	15	13	12	15	15	12	11	10

ON THE DISTRIBUTION OF RAIN FOR THE YEAR 1869.

UPON this head the following comparison tables afford full details, giving for nearly a hundred stations the results of twenty years uninterrupted observations. Being precisely similar in arrangement to those given last year, it does not seem necessary to enter on any lengthy explanation of their construction. We proceed, therefore, to examine the information afforded. A glance at the English table shows that the plus signs are more numerous than the minus ones, the proportion being 35 to 16, say as 2 to 1, and therefore, that the fall in England was rather above the average. Closer scrutiny shows that (with two or three exceptions, due probably to records not kept with perfect accuracy) the geographical distribution of the rain of 1869 is readily understood. There was a marked deficiency in the extreme south-west, in Devon and Cornwall, and a slighter one in the north-eastern counties. Between these two localities very considerable excesses prevailed; in fact, all over the midland counties the rainfall was above the mean, by amounts ranging from 1 to 25 per cent., and averaging 15 per cent. At a great many stations the fall was within one or two per cent. of the mean, and taking the average of all English stations, we find the rainfall of the year to have been 5 per cent. above the mean.

Although the Scotch returns still exhibit those great irregularities to which we have often called attention, they do not *wholly* mask the effect of the great deficiency in the southern half of the country, but leave the average deficiency as only 3 per cent., instead of 7 per cent., which we think nearer the truth. The fact is, not only in Ross-shire and Skye, but all over the country, there is much to be done. With a few distinguished exceptions, such as Deanston, Glencorse, Castle Toward, Arddaroch, and Haddington, there are hardly any registers available for determining the secular variation of Scottish rainfall, except those at the various lighthouses. Rightly or wrongly, wrongly we think, these gauges are accused of catching more salt water than fresh, *i.e.*, of collecting large quantities of sea spray; uncertainty being thus introduced, it renders it unsafe to rely wholly upon them, and hence it

is most necessary that registers should be commenced and steadily continued in the inland districts. At present it is most difficult to ascertain any of the broad features of secular variation in the country, and to eliminate the effects of faulty returns. Examination of the table will show that the deficiency was greatest in the south-east of Scotland, and extended some distance northward, but was less marked. In Ross-shire the deficiency was trifling, and in the Orkneys there was an *excess*.

Although we have only half-a-dozen returns from Ireland which are perfect for the year 1869, and extend back to 1850, yet these few appear to correspond to what has occurred on this side of the Channel. At Cork (as at Helstone) there was a deficiency, in the middle there was an excess, and in the north again a deficiency.

Grouping all the stations together, the apparent anomaly results that the fall of rain in 1869 was three-quarters of an inch *below* the mean of 1860—65, and that it was 1 per cent. *above* the same mean. Those of our readers who are used to figures will at once see the cause of this result; those who are not, will perhaps run over the following table, which gives an *imaginary and intentionally exaggerated* illustration of the cause of the apparent contradiction.

	Mean 1860—5.	Depth in 1869.	Difference from average.	
			Amount.	Per cent.
	ins.	ins.	ins.	
Station A	120·00	60·00	— 60·00	— 50
,, B	24·00	48·00	+ 24·00	+ 100
Sums	144·00	108·00	— 36·00	+ 50
Means	72·00	54·00	— 18·00	+ 25

From this it is evident that at the imaginary stations A and B there was an average *deficiency* of 18 ins., or 25 per cent. of their mean fall, and from the last column it is equally evident that there was an *excess* of 25 per cent. The cause of the discordance is too obvious to require further explanation.

We need not stop to point out that for questions of secular variation, the mean per-centage of excess, is a far more trustworthy guide than the mean amount of excess.

Reverting, however, to the actual figures for 1869, they indicate that for the British Isles, taken as a whole, the fall was about 1 per cent. above the average.

COMPARISON OF THE RAINFALL IN 1869 WITH PREVIOUS YEARS.

ENGLAND AND WALES.

Div.	STATION.	COUNTY.	Average			Depth in 1869.	Difference from Average, 1860-5	
			1840-9	1850-9.	1860-65.		Amount.	Per cent
			in.	in.	in.	in.	in.	
I.	Camden Town	Middlesex	...	(24·30)	25·01	25·42	·41 +	2
II.	Chichester Infirmary	Sussex	29·10	26·67	29·01	27·35	1·66 —	6
,,	,, (Shopwyke)	,,	...	26·25	28·41	29·50	1·09 +	4
,,	,, (Chilgrove)	,,	33·41	32·23	32·77	33·38	·61 +	2
,,	,, (W. Dean)	,,	...	35·30	37·02	37·49	·47 +	1
,,	Uckfield Observatory	,,	...	30·03	31·50	28·57	2·93 —	9
,,	Ventnor, Isle of Wight	Hants	...	28·46	29·26	27·94	1·32 —	5
III.	Hemelhempstead	Herts	25·86	26·43	25·47	27·67	2·20 +	9
,,	Berkhempstead	,,	...	28·05	28·02	29·11	1·09 +	4
,,	Hitchin	,,	..	24·72	23·25	23·55	·30 +	1
,,	High Wycombe	Bucks	...	23·20	24·29	27·94	3·65 +	15
,,	Althorp	Northants	...	20·34	21·77	26·19	4·42 +	20
,,	Cardington (8 in. gauge)	Bedford	...	21·60	21·87	21·25	·62 —	3
IV.	Epping	Essex	26·99	23·18	26·05	21·37	4·68 —	18
,,	Witham	,,	...	20·55	20·73	21·90	1·17 +	6
,,	Norwich (Honingham)	Norfolk	...	25·99	23·28	28·78	5·50 +	24
,,	Holkham	,,	...	26·13	23·10	25·63	2·53 +	11
V.	Baverstock	Wilts	31·09	28·69	29·57	27·28	2·29 —	8
,,	Plymouth (Ham)	Devon	...	44·70	42·17	37·82	4·35 —	10
,,	Exeter Institution	,,	29·35	26·91	30·17	32·65	2·48 +	8
,,	Honiton (Broadhembury)	,,	35·14	32·75	34·28	29·98	4·30 —	13
,,	Helston	Cornwall	...	36·22	38·05	32·60	5·45 —	14
,,	Truro	,,	43·81	40·00	42·56	37·82	4·74 —	11
,,	Bodmin	,,	...	43·48	46·12	43·44	2·68 —	6
VI.	Cirencester	Gloucester	...	29·60	30·87	36·53	5·66 +	18
,,	Burford	Shropshire	...	25·52	26·25	30·78	4·53 +	17
,,	Shiffnal (Haughton Hall)	,,	...	24·02	23·74	27·97	4·23 +	18
,,	Orleton	Worcester	28·41	28·82	30·06	33·81	3·75 +	13
VII.	Wigston	Leicester	...	26·39	26·49	26·70	·21 +	1
,,	Southwell	Notts	...	19·65	19·54	23·90	4·36 +	22
,,	Welbeck	,,	25·44	23·29	24·02	26·50	2·48 +	10
,,	Derby	Derby	...	23·98	25·14	27·35	2·21 +	9
VIII.	Bolton (The Folds)	Lancashire	46·46	44·01	48·33	49·00	·67 +	1
,,	,, (Belmont)	,,	...	51·19	55·70	58·40	2·70 +	5
,,	Preston (Howick)	,,	...	34·28	38·09	41·00	2·91 +	8
,,	Ormskirk (Rufford)	,,	...	33·24	34·81	35·93	1·12 +	3
,,	Holker	,,	...	39·17	44·98	48·23	3·25 +	7
IX.	Redmires	Yorkshire	40·75	37·86	37·89	43·90	6·01 +	16
,,	Standedge	,,	...	49·58	52·17	57·25	5·08 +	10
,,	Halifax (Well Head)	,,	31·88	30·71	31·09	37·86	6·77 +	22
,,	Leeds (Holbeck, M. & Co.)	,,	...	20·91	21·98	21·05	·93 —	4
,,	York	,,	25·42	22·02	23·38	27·92	4·54 +	20
,,	Settle	,,	43·41	35·55	39·77	41·54	1·77 +	4
X.	Bishopwearmouth	Durham	19·94	16·91	21·16	17·85	3·31 —	16
,,	Seathwaite	Cumberland	...	126·98	153·47	150·11	3·36 —	2
,,	Keswick (Post Office)	,,	...	55·01	60·56	72·00	11·44 +	19
,,	Kendal (Kent Terrace)	Westmorel'nd	51·18	44·91	52·88	55·50	2·62 +	5
,,	Windermere (The Howe)	,,	...	72·13	89·65	82·07	7·58 —	9
XI.	Lampeter	Cardigan	...	(43·00)	43·81	47·23	3·42 +	8
,,	Holywell (Maes-y-dre)	Flint	..	24·25	23·58	30·38	6·80 +	29
,,	Guernsey	Channel Isds.	...	34·46	37·09	32·99	4·10 —	11

COMPARISON OF THE RAINFALL IN 1869 WITH PREVIOUS YEARS.

SCOTLAND.

Div.	STATION.	COUNTY.	Average			Depth in 1869.	Difference from Average, 1860-5	
			1840-9.	1850-9.	1860-65.		Amount.	Per cent
			in.	in.	in.	in.	in.	
XII.	Mull of Galloway	Wigtown	20·67	22·52	28·31	24·29	4·02 —	14
,,	Little Ross	Kirk'udbright	...	25·27	27·35	24·92	2·43 —	9
XIII.	Haddington	Haddington. .	23·77	24·35	26·93	19·40	7·53 —	28
,,	Cobbinshaw	Edinburgh ...	...	35·65	35·65	35·80	·15 +	0
,,	Glencorse	,,	...	36·96	36·77	32·40	4·37 —	12
,,	Inveresk	,,	25·81	24·72	30·05	19·68	10·37 —	35
XIV.	Bothwell Castle	Lanark	...	27·76	28·33	24·32	4·01 —	14
,,	Largs (Mansfield)	Ayr	...	43·06	48·63	46·20	2·43 —	5
XV.	Arddaroch	Dumbarton...	...	66·55	75·83	69·35	6·48 —	9
,,	Pladda	Bute	40·02	35·23	38·12	38·74	·62 +	2
,,	Mull of Cantyre	Argyll ..	45·76	41·19	44·61	31·60	13·01 —	29
,,	Rhinns of Islay	,,	33·79	30·58	32·66	31·24	1·42 —	4
,,	Castle Toward	,,	...	47·88	53·80	45·60	8·20 —	15
,,	Tyree (Hynish)	,,	...	73·90	84·77	66·63	18·14 —	21
,,	Lismore	,,	...	38·44	46·95	34·27	12·68 —	27
,,	Ardnamurchan	,,	...	38·50	47·94	35·86	12·08 —	25
XVI.	Isle of May	Fife	20·94	15·21	21·08	18·15	2·93 —	14
,,	Deanston	Perth	35·74	39·21	42·35	40·54	1·81 —	4
,,	Dundee (Hill Head)	Forfar	...	31·06	35·59	30·82	4·77 —	13
,,	,, (Craigton)	,,	...	31·87	35·64	30·07	5·57 —	16
,,	Arbroath	,,	...	25·08	29·71	23·73	5·98 —	20
XVII.	Girdleness [Aberdeen]	Kincardine ...	23·14	19·71	22·13	24·83	2·70 +	12
,,	Castle Newe	Aberdeen	...	32·99	34·60	29·81	4·79 —	14
,,	Buchanness	,,	26·84	23·40	22·51	27·23	4·72 +	21
,,	Kinnairdhead	,,	22·01	22·05	23·32	31·24	7·92 +	34
XVIII	Cromarty	Cromarty ...	..	23·67	27·80	20·05	7·75 —	28
,,	Barrahead	Inverness ...	31·60	32·67	32·62	27·19	5·43 —	17
,,	Island Glass	,,	34·98	31·92	23·86	46·37	22·51 +	94
,,	Cape Wrath	,,	38·86	36·94	39·59	40·58	·99 +	3
,,	Noss Head	,,	...	25·57	23·57	28·35	4·78 +	20
XIX.	Dunnethead	Caithness ...	27·39	22·09	25·93	18·93	7·00 —	27
,,	Pentland Skerries	,, ..	...	24·12	28·92	29·75	·83 +	3
,,	Sandwick	Orkney	...	36·14	36·79	43·43	6·64 +	18
,,	Start Point	,,	25·05	23·77	24·32	44·11	19·79 +	81
,,	Sumburghhead	Shetland	25·43	25·22	25·52	27·64	2·12 +	8
,,	Bressay Manse	,,	...	36·22	40·40	40·90	·50 +	1
		IRELAND.						
XX.	Cork	Cork	41·30	34·23	34·41	32·55	1·86 —	5
,,	Killaloe	Clare	...	38·33	46·70	50·57	3·87 +	8
,,	Tullamore	King'sCounty	...	24·37	28·09	28·46	·37 +	1
XXI.	Black Rock	Dublin	23·20	21·78	25·83	29·69	3·86 +	15
XXIII	Armagh	Armagh	...	(28·20)	32·40	29·64	2·76 —	9
,,	Belfast (Linen Hall)	Antrim	29·44	30·01	37·12	35·44	1·68 —	5
		ABSTRACT.						
	England		...	33·60	35·89	37·03	1·14 +	5
	Scotland		...	32·54	35·64	33·45	2·19 —	3
	Ireland		...	29·49	34·09	34·39	·30 +	1
	Mean of the whole		...	31·88	35·21	34·96	—·75 +	1

EXTREMES OF RAINFALL IN 1869.

ENGLAND.

Greatest.	in.	Least.	in.
The Stye, Cumberland	198·19	North Sunderland	20·09
Taylor's Gill ,,	179·07	Bedford	20·34
Seathwaite ,,	150·11	Aston Rowan	20·42
Stye Head ,,	133·70	Shoeburyness	20·59
Sprinkling Tarn,,	126·95	Acol	20·60
Langdale	118·50	Clementhorpe	20·70

WALES.

Greatest.	in.	Least.	in.
Rhiwbrifdir	107·55	Great Orme's Head	27·96
Festiniog	85·51	Trevalyn Hall	27·99
Brithdin	77·24	Wrexham	28·74
Glyn Padarn	73·66	Maes y dre	30·38
Machynlleth	70·57	Cowbridge	31·20
Mardy, Aberdare	70·35	Lynn Onn	31·22

SCOTLAND.

Greatest	in.	Least.	in.
Upper Glencroe	121·50	East Linton, Haddington	15·77
Bridge of Orchy, Argyll	119·70	Smeaton, Haddington	18·38
Ardlui, Loch Lomond	117·50	Dalkeith	18·49
Arrochar, Dumbarton	117·30	Meadowfield	19·02
Firkin	93·50	Millfield	19·40
Glengyle	91·00	Inveresk	19·68

IRELAND.

Greatest.	in.	Least.	in.
Kenmare, Killarney	59·47	Coollattine Park	24·05
Valentia	54·55	Antrim	26·66
Letterkenny, Donegal	52·86	Fitzwilliam Square, Dublin	27·56
Galway	52·19	Phœnix Park, Dublin	27·57
Killaloe	50·57	E. Lodge, Monkstown	28·05
Mount Shannon	48·79	Drumcashel	28·23

GENERAL TABLES

OF

TOTAL RAINFALL IN 1869,

AT ABOUT

1500 STATIONS

IN THE

BRITISH ISLES.

RULES FOR RAINFALL OBSERVERS.

[We do not like the word "Rules;" it has a dictatorial appearance entirely at variance with our wishes and intention. Our sole object in framing them has been to ensure uniformity and accuracy. Any observer who objects to, or can suggest improvements in any one of them, will oblige by forwarding the substitute he would prefer, and a short statement of his reasons for so doing. These shall appear in the next issue of the *Meteorological Magazine*, and the rule shall be altered or not, as decided by the observers themselves.]

I.—SITE.—A rain gauge should not be set on a slope or terrace, but on a level piece of ground, at a distance from shrubs, trees, walls, and buildings—at the very least, as many feet from their base as they are in height. Tall-growing flowers, vegetables, and bushes must be kept away from the gauge. If a thoroughly clear site cannot be obtained, shelter is most endurable from N.W., N., and E., less so from S., S.E., and W., and not at all from S.W. or N.E.

II.—OLD GAUGES.—Old established gauges should not be moved, nor their registration discontinued until, at least, two years after a new one has been in operation, otherwise the continuity of the register will be irreparably destroyed. Both the old and the new ones must be registered at the same time.

III.—LEVEL.—The funnel of a rain gauge must be set quite level, and so firmly fixed, that it will remain so in spite of any gale of wind or ordinary circumstance.

IV.—HEIGHT.—The funnel of gauges newly placed should be 1 ft. above grass Information respecting height above sea level may be obtained from the Editor.

V.—RUST.—If the funnel of a japanned gauge becomes so oxidised as to retain the rain in its pores, or threatens to become rusty, it should have a coat of gas tar, or japan black. [Ebonite funnels will probably soon be obtainable.]

VI.—FLOAT GAUGES.—If the measuring rod is detached from the float, it should never be left in the gauge. If it is attached to the float, it should be pegged or tied down, and only allowed to rise to its proper position at the time of reading. To allow for the weight of the float and rod, these gauges are generally so constructed as to

show 0 only when a small amount of water is left in them. Care must always be taken to set the rod to the zero or 0.

VII.—CAN AND BOTTLE GAUGES.— The measuring glass should always be held upright; the reading is to be taken midway between the two apparent surfaces of the water.

VIII.—TIME OF READING.—Nine a.m. daily; if only taken monthly, then 9 a.m. on 1st.

IX.—DATE OF ENTRY.—The amount measured at 9 a.m. on any day is to be set against the previous one; because the amount registered at 9 a.m. of, say, 17th contains the fall during 15 hours of the 16th, and only 9 hours of the 17th. *(This rule has been approved by the Meteorological Societies of England and Scotland, cannot be altered, and is particularly commended to the notice of observers.)*

[Far be it from me to complain of those who by regular and careful observation provide the materials on which this work is founded, but I do wish they would *all* conform to this rule. I believe that some think it is of little consequence, and others are not aware how strongly it has been endorsed by the only meteorogolical societies in the country. Perhaps the former will take into consideration the fact that besides costing me hours of extra work, it seriously impairs the value of their registers. For the information of the latter class of observers, I annex *verbatim* extracts from the reports of the councils of the two societies.]

"Mr. Buchan stated that the mode of entering the rainfall by the Society's observers was not uniform; some, by far the greater number, entering the rain read off on the 1st of the month as the fall for that day, others entering it as the fall for the last day of the previous month. He recommended, as it is most desirable that one uniform method be adopted, that observers be instructed to read the rain gauge at 9 a.m., and enter that reading for the day previous; and where the readings are not taken daily, that the gauge be always read on the 1st of each month, and the amount then collected be considered as belonging to the previous month, and entered accordingly. The Council agreed to sanction this recommendation, and would strongly urge those observers who have not yet adopted it, to do so without delay."—*Minute of Council of the Scottish Meteorological Society, April*, 1866.

"The date to which each measurement of rain is to be entered (and which, therefore, involves the termination of the rain month) having been referred to the observers, to ascertain the general practice, it was found that the majority were in favour of 9 a.m., and placing the amount then measured against the day preceding that on which it was measured. This regulation met Mr. Glaisher's approval, and has also received the support of the Council of the Scottish Meteorological Society, who have passed a minute instructing their observers to adopt it. By these means it is hoped that very shortly the practice will be uniform throughout the United Kingdom."—*Report of the Council of the Meteorological Society, June*, 1866.

X.—Mode of Entry.—If less than one-tenth (·10) has fallen, the cypher must *always* be prefixed; thus, if the measure is full up to the seventh line, it must be entered as ·07, that is, no inches, no tenths, and seven hundredths. For the sake of clearness, it has been found necessary to lay down an invariable rule that there shall always be two figures to the right of the decimal point. If there be only one figure, as in the case of one-tenth of an inch (usually written ·1) a cypher must be added, making it ·10. Neglect of this rule causes much inconvenience. All columns should be cast up *twice.* When there is no rain, a line should be drawn rather than cyphers inserted.

XI.—Caution.—The amount should always be written down before the water is thrown away.

XII.—Small Quantities.—The unit of measurement being ·01, observers whose gauges are sufficiently delicate to show less than that, are, if the amount is under ·005, to throw it away, if it is ·005 to ·010 inclusive, they are to enter it as ·01.

XIII.—Absence.—Every observer should train some one as an assistant; but where this is not possible, instructious should be given that the gauge should be emptied at 9 a.m. on the 1st of the month, and the water bottled, labelled, and tightly corked, to await the observer's return.

XIV.—Heavy Rains.—When very heavy rains occur, it is desirable to measure immediately on their termination, and it will be found a safe plan after measuring to return the water to the gauge, so that the morning registration will not be interfered with. Of course if there is the slightest doubt as to the gauge holding all that falls, it must be emptied, the amount being *previously* written down.

XV.—Snow.—In snow three methods may be adopted—it is well to try them all. (1) Melt what is caught in the funnel, and measure that as rain. (2) Select a place where the snow has not drifted, invert the funnel, and turning it round, lift and melt what is enclosed. (3) Measure with a rule the average depth of snow, and take one-twelfth as the equivalent of water. Some observers use in snowy weather a cylinder of the same diameter as the rain gauge, and of considerable depth. If the wind is at all rough, all the snow is blown out of a flat-funnelled rain gauge.

XVI.—Overflow.—It would seem needless to caution observers on this head, but as a recent foreign table contains *six instances on one day* in which gauges were allowed to run over, it is evidently necessary that British observers should be on the alert.

ARRANGEMENT OF GENERAL TABLES.

The divisions are the same as those adopted by the Registrars General of England and Scotland.

The boundaries of these divisions are shown on the map prefixed to *British Rainfall*, 1863.

The counties follow the same order as in the reports of the aforesaid officers.

An alphabetical list of the counties is given with the page or pages on which all returns from each will be found.

The stations in each county are arranged in the order of their latitude from South to North.

In order to facilitate finding the fall in any part of the country, the first name is almost always that of a place given in *Bradshaw*, the *British Postal Guide*, or the *Clergy List;* the second name is added occasionally to fix accurately the site of Observation. In a very few instances, this second name is in [ ] instead of ( ); it shows the nearest town, which is then in an adjoining county. For instance, "Lowestoft (Gisleham)" means Gisleham, near Lowestoft, both being in one county, but "Geldeston [Beccles]" means Geldeston, Norfolk, near Beccles, in another county—Suffolk.

The contents of the columns are sufficiently explained by the headings, except that in the column headed "diameter" figures will occasionally be noticed of a different type from the rest of the tables; these figures indicate the length of the sides of rectangular mouthed gauges. These measurements are all in inches.

An asterisk * denotes that the gauge was tested before erection, and a † that it has been visited and examined since. A note of interrogation (?) implies doubt, not necessarily error. ... indicates the absence of information.

BA is employed to indicate gauges originally provided out of the funds of the British Association.

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ENGLAND AND WALES.

DIVISION I.—MIDDLESEX.

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground ft.	in.	Height Above Sea Level feet.	Depth of Rain. 1869 inches.	Days on which '01 or more fell.
MIDDLESEX.							
Hampton Wick (The Grove) ...	T. J. Nelson, Esq.....	5	1	1	27	23·76	140
„ (Fairlight).....	C. Mostyn, Esq.....	5	1	1	52	25·52	142
Teddington (Gomer House)	R. D. Blackmore, Esq...	5	0	10	26	25·08	159
Twickenham Observatory.....	W. E. Plummer, Esq...	10	0	9	28	?20·06	...
Hammersmith (New Road)	F. J. Burge, Esq.	...	1	0	12	23·83	...
Kensington (Holland Road).....	H. Doxat, Esq.	5	1	0	..	24·49	160
Ealing (Castlebar Road)	Ealing Local Board ...	5	1	0	120	25·54	...
Westminster(SpringGrdns),S.W.	J. Grant, Esq., C.E. ...	8	6	8	36	23·76	...
„ „ „	„ „ „ ...	...	65	3	95	21·32	...
„ „ „	„ „ „ ...	...	64	9	95	22·11	...
London (Guildhall), E.C.	W. Haywood, Esq.C.E	8	2	6	49	23·47	151
„ „	„ „ „	8	50	0	98	22·88	151
„ (Chiswell Street), E.C....	A. Slate, Esq.	5	51	0	...	22·80	129
„ (Mile End), E.	F. Charrington, Esq....	12	14	0	...	24·25	133
† „ (Camden Square), N.W..	G. J. Symons, Esq. ...	8	0	6	111	25·42	146
„ Islington(St.Mary'sRoad,N.)	W. T. Reynolds, Esq...	5	1	0	117	23·82	153
„ „ (Compton Terrace).	Dr. Ballard	8	0	6	122	25·24	153
† „ (Holloway) N.	W. B. Kesteven, Esq.	5	1	3	95	25·34	169
*Kentish Town Reservoir Bank...	G. J. Symons, Esq. ...	5	1	0	200	24·26	...
*Upper Clapton (Hadham Ho.) ...	J. Parnell, Esq.	5	1	1	91	24·04	178
Hampstead, N.W. (Roslyn Ho.)	C. H. L. Woodd, Esq..	...	1	4	370	24·49	...
† „ (Squire's Mount).....	Rogers Field, Esq. C.E.	5	1	0	385	25·88	142
† „ (The Grove)	H. Sharpe, Jun., Esq...	5	2	0	440	24·12	156
† „ „	„ „ „ „	5	50	0	471	19·47	148
†Highgate Nurseries	J. Cutbush, Esq.	5	1	0	394	24·29	142
Harrow-on-the-Hill	T. Hewlett, Esq.	5	1	2	354	24·63	190
„ Station	B. Haughton,Esq.,C.E.	5	1	0	188	26·43	138
„ (Northwick House)	H. St. J. Joyner, Esq.	5	0	6	200	27·11	165
†Tottenham (Grove Ho.).....	Charles Ashford, Esq..	5	1	0	55	25·82	166
Uxbridge (Harefield Park)	W. F. Vernon, Esq. ...	8	0	8	290	25·69	119

DIVISION I.—MIDDLESEX—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter	Height Above Ground. ft.	in.	Height Above Sea Level feet.	Depth of Rain. 1869 inches.	Days on which 01 or more fell.
MIDDLESEX—(*con.*)							
Mill Hill (Bittacy House)	J. A. Hadam, Esq. ...	5	1	0	420?	27·74	141
Enfield (Nag's Head Lane)	W. C. Mylne, Esq. ...	...	3	0	89	29·08	178
† Winchmore Hill	T. Paulin, Esq.	8	1	0	350?	25·05	138
„ „	„ „ „	5	1	0	350?	25·24	138
Potters' Bar.....	Mrs. Kaye	3	0	8	...	24·02	...

DIVISION II.—SOUTH-EASTERN COUNTIES.

SURREY.							
Godalming (Dunsfold)	Mr. T. Underwood ...	5	2	6	166	28·98	...
Weycombe [Haslemere]	G.B.Buckton,Esq.FRS	5	4	0	582	38·19	...
Guildford (Cranleigh)	Rev. R W. Tayler ...	5	0	8	...	29·77	...
„ (Ewhurst)	Capt. James, R.E.....	5	1	6	345	30·81	...
Farnham (Culverlands)	Miss Gibson	5	1	1	300	29·89	185
Godalming (Elstead)	Capt. James, R.E.....	5	1	6	165	28·35	...
Guildford (Shalford Common) ...	„ „ „	10	1	6	115	29·99	119
Albury Postford	„ „ „	5	1	6	200	29·28	...
† „ (Commercial Road) ...	„ „ „	10	1	6	120	31·49	126
Dorking (West Street)	Mrs. W. A. Marsh ...	10	35	0	150?	31·64	158
„ (TheShrubbery,BoxHill)	E. Boorman, Esq.....	8	4	0	500?	23·90	...
Cobham (Pyports)	G. Dines, Esq.	8	1	0	66	25·21	165
„ „ .....*monthly*	„ „ „ ...	5	1	0	66	25·72	...
Chobham	Dr. Ward	8	1	2	93	25·28	144
† Weybridge Heath	W. F. Harrison, Esq...	8	0	6	150	27·05	...
Bagshot Park	Sir J.Clark, Bt., F.R.S..	5	1	0	130	21·53	...
Croydon (South End).....	Dr. Westall	5	1	6	152	25·04	144
„ (Tanfield Lodge)	J. Weston, Esq.....	5	1	0	...	25·98	...
„ (Belfield).....	J. Rickett, Esq.	5	7	6	180	25·96	...
„ (Waldronhurst)	C. W. Johnson, Esq. ...	8	28	0	217	23·64	...
Kingston-on-Thames	E. Chalk, Esq	5	0	6	...	24·92	...
Wimbledon	T. Devas, Esq.	12	3	0	170	23·35	...
Upper Tooting.....	D. A. Freeman, Esq...	5	0	6	86	23·59	...
*Brixton Hill.....	Miss Sweeting	5	1	0	127	25·91	165
Wandsworth (South Fields).....	R Coleman, Esq.	4	0	10	...	24·33	...
† „ (West Hill)	J. E. Richard, Esq. ...	3	0	10	86	23·88	87
† Kew Observatory	Dr. Stewart, F.R.S. ...	10	1	3	19	22·63	150
KENT.							
† Tenterden (Maytham Hall)	R. Appach, Esq.	8	1	2	120	28·72	154
† Hythe	H. B. Mackeson, Esq..	8	0	8	12	33·11	209
† Dover (Castle Street).....	H. J. Poulter, Esq. ...	5	2	2	52	30·50	160
† Hythe (Horton Park)	J. Kirkpatrick, Esq....	8	1	6	350	30·89	...
† Cranbrook (Hartley)	G. Pile, Jun. Esq.....	5	4	0	352	31·49	218
† „ (Tillsden)	T. Pile, Esq.	...	0	3	...	37·30	...
Goudhurst Vicarage	Rev. J. S. Clarke	5	1	1	419	27·11	...
† Tunbridge	Dr. Fielding	5	1	0	71	30·09	187
Edenbridge (New Falconhurst)...	J. G.Talbot, Esq., M.P.	5	1	0	400	32·56	165
† Maidstone (Linton Park)	Mr. J. Robson	8	0	6	296	29·09	162

DIVISION II.—SOUTH-EASTERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter	Rain Gauge. Height Above Ground.	Rain Gauge. Height Above Sea Level	Depth of Rain. 1869	Days on which ·01 or more fell.
			ft. in.	feet.	inches.	
KENT—(*con*).						
† Maidstone (East Sutton Park)	Mr. T. Skinner	8	0 6	387	27·27	86
† „ (Hunton Court)	Mr. P. Goddard	8	0 6	80	28·18	153
Charing (Otterden)	Rev. W. A. Paxton	...	...	507	28·76	...
† East Peckham (Orchard Cottage)	S. T Harris, Esq.	5	2 0	76	27·56	135
† Faversham (Brogdale)	W. C. Stunt, Esq.	5	0 10	140	28·15	164
† Canterbury (Chartham)	C. T. Drew, Esq.	8	2 6	40	27·22	159
„ (Bridge Street)	J. Reid, Esq.	5	1 0	52	29·16	180
† Sandwich (Walton House, Eastry)	Colonel Rae	5	1 2	53	24·29	..
† Maidstone (Larkfield)	Rev. N. Dimock	5	3 6	95	29·13	...
† „ (Somerfield)	F. H. Holmes, Esq.	20	1 5	...	28·43	...
Seven Oaks (River Hill)	J. T. Rogers, Esq.	8	4 6	530	31·54	112
„ (Riverhead Vic.)	Rev. J. B. Murdoch	5	1 0	...	37·34	167
† Westerham (Chartwell)	J. C. Colquhoun, Esq.	5	0 6	400 ?	32·35	...
Selling (Harefield)	E. Neame, Esq.	5	2 6	217	25·56	173
† Margate (Acol)	E. S. Lendon, Esq.	5	1 0	60	20·60	...
„ (Bloxham's Green)	W. Lane Sear, Esq.	5	6 0	35	20·81	139
Bickley (Gordon Lodge)	G. F. Chambers, Esq.	5	1 0	240	21·97	...
Bromley Common, S.E.	Rev. A. Rawson	8	1 3	250	27·88	151
Foot's Cray (Sidcup)	Miss Berens	5	0 8	...	25·40	...
Lee (Blessington Road)	J. Grant, Esq., C.E.	10	4 9	49	26·14	...
† Beckenham (Parkside)	C. O. F. Cator, Esq.	8	0 3	142	25·42	159
† „ „ *monthly*	„ „	5	0 4	142	24·30	...
† „ „	„ „	5	50 0	200	19·10	...
† „ (Foxgrove)	Percy Bicknell, Esq.	5	0 5	141	26·23	...
† „ „	„ „	5	4 0	145	25·20	...
Dartford (The Downs)	R. F. Jarvis, Esq.	5	2 0	250	22·51	147
† Eltham Green	Mr. E. J. C. Smith	5	1 0	76	24·92	160
Greenwich (Royal Observatory)	J. Glaisher, Esq., F.R.S.	8	0 5	155	24·02	...
Deptford (Pumping Station)	W. Jeffree, Esq.	10	3 8	18	27·75	148
Erith (Crossness)	F. E. Houghton, Esq.	11	0 6	16	27·14	145
„ „	„ „ „	10	0 6	6	27·63	145
„ „	„ „ „	11	0 6	24	29·00	145
WEST SUSSEX.						
† Bognor (Aldwick)	H. Upton, Esq.	5	1 0	50	23·54	...
† Worthing (Bedford Row)	W. J. Harris, Esq.	5	0 9	17	25·30	160
„ „	„ „ „	8	0 6	17	25·93	160
„ (Water Works) (*monthly*)	„ „ „	5	0 11	25	27·74	...
† Arundel (Yapton)	R. Redford, Esq.	5	1 0	24	29·42	158
Emsworth (West Thorney)	F. Padwick, Esq.	5	0 10	10	24·78	121
† Chichester (Infirmary = Museum)	W. Hills, Esq.	5	0 6	50	27·35	...
† „ (Westgate)	Dr. Tyacke	4	0 6	40	26·91	...
† „ (Shopwyke)	Rev. G. H. Woods	8	1 3	61	29·50	...
† Arundel (Dale Park)	J. C. Fletcher, Esq.	11	3 0	316	30·64	96
† Steyning	Rev. Hugh Ingram	5	1 0	80	37·02	148
† Chichester (West Dean)	H. Paxton, Esq.	8	1 4	250	37·49	169
† „ (Chilgrove)	John W. Woods, Esq.	5	0 6	284	33·38	...
† „ (Bepton Hill)	„ „ „	5	0 6	554	38·85	...

DIVISION II.—SOUTH-EASTERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground. ft.	in.	Height Above Sea Level feet.	Depth of Rain. 1869 inches.	Days on which ·01 or more fell.
WEST SUSSEX—(*con.*)							
†Petworth Rectory	Rev. C. Holland	5	1	10	190	33·11	140
Midhurst (Lynch)	J. Eames, Esq.	...	0	6	160?	37·97	...
†Fernhurst [Haslemere]	Miss E. A. Salvin	8	0	10	301	32·09	119
Milland House [Liphook]	Rev. J. M. Heath	18	25	0	350	34·93	...
EAST SUSSEX.							
Eastbourne	Miss W. L. Hall	5	0	5	16	26·68	156
†Pevensey	M. Vidler, Esq., C.E.	8	4	0	10	22·56	153
Brighton (Cambridge Rd., Hove)	H. B. Peake, Esq.	5	1	0	111	26·73	...
„ (Buckingham Place)	F. E. Sawyer, Esq.	5	0	8	198	26·75	149
† „ (Eaton Place)	Dr. Barker	8	0	3	98	25·45	148
† „ (Water Works)	Brighton Water Co.	5	0	7	90	29·74	...
†Hastings (High Wickham)	E. Field, Esq.	5	1	2	212	27·82	...
† „ (Bleak House)	Mr. J. Banks	8	1	3	80	25·60	135
† „ (Cemetery)	Mr. Field	5	0	6	500	24·64	144
† „ (Hollington)	Capt. Lewis	5	1	0	315	27·22	150
†Lewes (Glynde)	Mr. J. McLeod	5	3	6	59	32·75	136
†Battle	F. Webster, Esq.	5	1	3	...	30·25	...
† „ Abbey	Mr. T. Jack	5	1	0	215	?20·88	...
†Uckfield	C. L. Prince, Esq.	12	6	0	149	28·57	131
†Newick (Ketches)	Miss Shiffner	8	0	5	192	27·71	151
†Maresfield (Rectory)	Rev. E. Turner	8	1	2	250	29·80	140
† „ (Forest Lodge)	Captain W. Noble	8	1	2	259	31·78	153
†Hayward's Heath (Asylum)	Rev. T. E. Crallan	5	1	0	250	30·61	182
†Salehurst (Church House)	E. Boorman, Esq.	5	4	2	75?	26·93	...
Cuckfield (Balcombe Place)	J. A. Hankey, Esq.	8	1	3	340	33·88	166
East Grinstead	W. V. K. Stenning, Esq.	5	1	3	400?	31·51	170
HAMPSHIRE.							
Isle of Wight (Niton)	Rev. R. C. Kempe	8	0	4	100?	30·82	...
† „ „ (St. Lawrence)	Rev. C. Malden	5	1	0	75	30·94	159
† „ „ (Ventnor)	Dr. Martin	12	3	7	100	27·94	129
„ „ (Newport)	Mr. E. G. Aldridge	5	12	9	57	36·83	144
† „ „ (Ryde)	R. Taylor, Esq.	12	7	0	20	34·65	135
† „ „ (Osborne)	J. R. Mann, Esq.	8	0	6	172	32·41	126
Bournemouth (Holmwood)	Dr. Compton	5	0	4	128	28·56	168
Lymington (Wainsford)	H. Fawcett, Esq.	5	1	2	58	28·77	151
Southampton (Bourne Cottage)	A. H. Hogg, Esq.	8	2	0	25	29·31	122
„ (Cadland)	„ „ „	8	4	6	100	33·82	143
Fareham	H. Sharland, Esq.	5	0	2	26	32·52	...
Havant (Bedhampton)	J. N. Hillman, Esq.	5	1	0	...	29·92	162
„ (Leigh Park)	W. H. Stone, Esq., M.P.	8	0	8	110	29·01	128
Southampton, Ordnance Survey Office	Col. Sir H. James, R.E. F.R.S.	5	0	4	75	29·46	144
„ „ „	„ „ „ „	5	1	0	75	29·41	142
Southampton (Eling House)	W. C. Spooner, Esq.	14	18	6	92	26·27	143
„ (Shirley Warren)	R. C. Hankinson, Esq.	5	1	2	20	27·91	...
„ „ „ ...	„ „ „	5	4	0	105	30·04	174
Bishop's Waltham (Swanmore Ho)	B. Shearer, Esq.	5	0	6	100	29·60	174
		5	0	4	390	29·56	129

DIVISION II.—SOUTH-EASTERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground. ft.	in.	Height Above Sea Level feet.	Depth of Rain. 1869 inches.	Days on which ·01 or more fell.
HANTS—(*con.*)							
Winchester (Otterbourne) *daily*	J. B. Yonge, Esq.	5	1	3	115	27·83	134
„ „ *monthly*	„ „ „	5	1	3	115	29·04	...
Petersfield (Liss)	G. E. Coryton, Esq.	7	0	8	...	40·62	...
Alresford (Arle Bury)	F. Marx, Esq.	5	1	6	308	32·58	111
Woolmer Forest	Capt. E. James, R.E.	5	1	6	297	25·23	...
Selborne (The Wakes)	T. Bell, Esq.	6	4	0	400	35·87	142
Aldershot	Mr. J. Arnold	8	0	6	325	29·17	166
„ „ „	„ „ „	5	3	0	328	28·24	166
„ „ „	„ „ „	5	6	0	331	27·22	166
„ „ „	„ „ „	5	12	0	337	25·43	166
„ „ „	„ „ „	8	25	0	350	20·37	166
„ (Bourley—2 miles W.)	„ „ „	8	1	0	370	29·57	164
†Basingstoke (Eastlands)	G. Stephens, Esq.	5	1	0	306	31·51	159
† „ (Wote Street)	T. Sweeting. Esq.	5	1	0	265	31·17	161
† „ (Sherborne St. John)	Rev. D. W. Chute	5	1	2	276	28·85	143
† „ (The Vyne)	W. Wiggett Chute, Esq.	8	1	2	236	26·75	133
† „ „ „	„ „ „	3	0	11	236	28·03	133
†Strathfield Turgiss	Rev. C. H. Griffith	5	3	0	209	25·56	120
† „ Saye	Mr. J. Bell	8	1	0	183	24·64	135
BERKS.							
Sunningdale (Lynwood)	Admiral Sir F. W. Grey	8	0	9	264	28·83	155
Windsor (Cumberland Lodge)	Viscount Bridport	5	1	0	200	27·59	114
„ (Woodside)	W. Devas, Esq.	5	0	10	...	23·60	133
†Reading (Englefield)	E. Robinson, Esq.	5	1	0	...	26·16	127
† „ (Forbury Gardens)	Mr. Davis	5	1	3	150	23·90	120
† „ (Russell Street)	Dr. Workman	5	2	8	159	24·31	158
Newbury (Greenham)	J. Ward, Esq.	5	1	0	235	27·76	171
„ (Welford Park)	Mr. C. Ross	5	0	11	335	30·06	167
Maidenhead (White Waltham)	Mr. J. Silver	8	1	6	...	22·31	...
„ (Ray Lodge)	W. Lassell, Esq., F.R.S	6	1	0	90	25·34	...
Streatley Vicarage	Rev. J. Slatter	10	0	4	144	27·79	...
Maidenhead (Cookham Vic.)	Rev. R. W. Rogers	5	1	3	60?	26·89	177
„ (The Halls)	F. W. Jowers, Esq.	5	1	6	70	26·87	171
*Wantage	E. C. Davey, Esq.	5	12	8	185	26·46	152
Wallingford (The Castle)	J. Kirby Hedges, Esq.	5	0	9	175	25·16	105
Long Wittenham	Rev. J. C. Clutterbuck	12	1	6	170	28·84	136
Abingdon	W. Belcher, Esq.	5	1	0	180	24·57	152

DIVISION III.—SOUTH MIDLAND COUNTIES.

HERTS.							
Hoddesdon (Field's Weir)	N. Beardmore, Esq. C.E.	24	2	0	82	27·16	136
Bayfordbury	W. C. Baker, Esq.	8	0	4	250	26·34	161
St. Albans (Gorhambury)	Mr. G. Bogue	6	2	9	...	27·72	134
Hemelhempstead (Nash Mills)	J. Evans, Esq., F.R.S.	12	3	0	250	27·67	158
Berkhampstead	W. Squire, Esq.	8	1	6	370	29·11	163
Tring (Cowroast)	H. Thomas, Esq.	10	4	2	345	27·53	151
Kensworth [Dunstable]	T. Jones, Esq.	5	1	0	902	22·40	...

DIVISION III.--SOUTH MIDLAND COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which ·01 or more fell.
		Diameter	Height Above Ground.	Height Above Sea Level	1869	
			ft. in.	feet.	inches.	
HERTS—(*con.*)						
Ware (Much Hadham)	Rev. H. S. Mott	5	1 1	222	27·55	156
Stevenage	Rev. J. O. Seager	8	4 2	321	27·56	150
„ (Woodfield)	J. B. Denton, Esq. ,C.E.	...	1 6	300	27·39	117
Buntingford (Aspenden Rectory)	Rev. A. P. Sanderson	5	1 1	320	28·64	133
Hitchin	W. Lucas, Esq.	8	1 6	238	23·55	161
Royston	H. Wortham, Esq.	8	0 6	266	24·56	147
BUCKINGHAMSHIRE.						
Eton	Rev. Herbert Snow	5	1 0	100	25·53	148
High Wycombe	H. S. Wheeler, Esq.	8	0 9	225	27·94	...
Missenden Abbey	J. Begbie, Esq.	6	1 0	...	30·67	...
Wendover (Cholesbury)	Rev. H. P. Jeston	...	...	...	29·13	...
Newport Pagnell	R. Littleboy, Esq.	5	2 0	...	24·69	...
OXFORD.						
Henley-on-Thames	T. F. A. Byles, Esq.	5	4 0	90	28·05	...
„ (Nuffield)	Rev. A. Hamersley	5	4 0	698	25·43	...
Watlington (Swyncombe House)	Mrs. Ruck Keene	5	0 4	500?	26·96	...
Thame (Aston Rowant)	T. Taylor, Esq.	8	1 0	405	20·42	...
Oxford (Radcliffe Observatory)	Rev. R. Main, F.R.S.	10	0 8	210	26·47	154
„ „	„ „	10	22 0	232	24·84	151
„ (Upper Heyford)	Rev. C. B. Mount	9	1 2	300?	26·65	149
*Bicester (Stratton Audley Pk)	G. Glen, Esq.	5	1 1	295?	26·55	...
Chipping Norton (Kingham)	Rev. J. W. Lockwood.	5	3 6	442	29·62	...
Banbury (Broughton Lodge)	E. C. Morrell, Esq.	5	2 0	360?	27·61	178
„ (Sibford)	R. Routh, Esq.	5	1 0	601	28·38	152
„ (High Street)	T. Beesley, Esq.	6	7 0	350	28·49	180
„ (Neithrop)	F. Francillon, Esq.	5	1 0	340	27·37	...
NORTHAMPTON.						
Potterspury [Stony Stratford]	Rev. R. E. Crawley	5	0 4	...	26 27	170
Yardley-Hastings	Rev. R. W. Prichard	5	1 2	260	23·70	...
Weedon Beck	Rev. J. S. Winter	8	1 6	280	25·26	...
Northampton	H. Terry, Esq.	5	5 0	...	24·90	162
„ (Thorpelands)	H. J. Little, Esq.	8	0 6	260	24·91	146
„ (Althorp House)	Mr. W. F. Jakeman	8	3 4	310	26·19	160
Wellingborough	E. Sharman, Esq.	5	0 3	...	24·27	169
Kettering	J. Wallis, Esq.	8	1 3	300	25·04	191
Rockingham Castle	Mr. J. Brown	5	1 0	300	27·78	93
Peterborough	Mr. E. Evans	5	1 6	...	27·52	...
Easton [Stamford]	Mr. Day	5	1 0	220	25·77	153
HUNTS.						
St. Neots, (Tetworth Hall)	Miss Kaye	5	0 6	114	24·08	152
„ (Waresley)	Rev. W. M. H. Elwyn	8	1 0	193	23·41	138
„	G. Bower, Esq.	5	1 6	60	21·25	...
Kimbolton (Hamerton)	Rev. A. F. Stopford	10	5 4	170	25·27	...
*Huntingdon (Wistow)	Rev. T. Woodruff	5	1 0	...	24·18	...
Conington Castle	J. M. Heathcote, Esq.	5	1 0	...	27·25	...
Standground Sluice, [Peterboro']	R. Lunn, Esq.	...	...	...	22·88	139

DIVISION III.—SOUTH MIDLAND COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground. ft.	in.	Height Above Sea Level feet.	Depth of Rain. 1869 inches.	Days on which ·01 or more fell.
BEDFORD.							
Woburn (Lindon)	W. Lynn Smart, Esq..	5	2	0	...	24·99	168
Stotfold [Baldock]	W. Denne, Esq.	5	0	9	224	22·53	146
Aspley Guise (Hayfield)	S. Douglas, Esq.	5	1	1	...	20·84	112
Ampthill	W. S. Slinn, Esq.	5	1	1	320	23·05	125
Biggleswade	C. T. Newbery, Esq...	5	5	6	...	22·02	...
Cardington	Mr. J. B. McLaren ...	8	0	0	106	21·25	...
„ (Staff gauge)	„ „ „	12	3	6	109	20·33	135
„	„ „ „	8	36	0	142	17·44	...
Bedford	D. Robie, Esq.	8	1	0	70	20·34	129
CAMBRIDGE.							
Abington Pigotts [Royston]	G. Pigott, Esq.	8	0	6	130	23·65	163
Pampesford Hall	Mr. A. McIntyre	5	1	0	112?	23·45	140
Granchester Mill	J. Nutter, Esq.	5	4	0	45	23·19	164
Cambridge (Beech House)	„ „ „	8	4	0	40	24·00	171
„ (Merton Villa)	G. Warren, Esq.	5	1	0	40	23·53	161
„ (Sidney Street)	Mr. W. E. Paine	8	51	0	83	21·80	...
* „ (Observatory)	Professor Adams, F.R.S.	5	0	9	88	23·42	164
Ely (Stretham)	Mr. Edwin Stanley ...	9	4	9	...	23·15	140
Wisbech (Harecroft Ho.)	A. Peckover, Esq.	8	0	8	11	26·56	152
„ (Observatory)	S. H. Miller, Esq.	8	0	6	10	26·52	146
„ „ (*monthly*)	„ „ „	5	0	6	10	25·92	...
„ „	„ „ „	8	8	0	18	25·49	146
„ „	„ „ „	20×10	35	0	45	21·89	...

DIVISION IV.—EASTERN COUNTIES.

ESSEX.							
Shoeburyness	Capt. Fairford Ellis, RA	5	4	0	12	20·59	112
Rochford (Clement's Hall)	A. Holt White, Esq....	8	4	0	25	22·26	124
Rayleigh (Hockly)	A. Cockey, Esq.	10	0	0	92	24·09	...
Brentwood (Sawyer's Hall Farm)	Rogers Field, Esq., C.E.	5	1	0	250?	23·81	105
*Billericay	Dr. Carter	5	1	0	...	22·13	...
Waltham Abbey	Captain Smith, R.A. ...	8	4	0	70	23·95	118
Epping	H. Doubleday, Esq. ...	8	6	0	370?	21·37	114
,, (The Hemnalls)	J. Nicholl, Esq.	8	0	9	...	25·55	151
Harlow (Sheering)	Rev. Edward Hill ...	5	1	0	214	25·94	170
„ (Moor Hall)	Mr. Huntley	8	1	6	220	24·52	149
Witham (Dorward's Hall)	H. Dixon, Esq.	6	1	6	20?	21·90	...
Dunmow (High Roding)	Rev. E. Maxwell	5	0	8	252	25·50	161
	H. E. Cockayne, Esq...	12	0	0	234	25·86	154
*Colchester (Birch Hall)	Mr. W. Ingle	5	1	0	80	25·78	137
„ (The Camp)	Sergeant Sheehan	8	1	0	109	23·39	146
„ (Broom Hill House)	Captain Walker	5	1	3	87	28·31	128
„ (Ford Street Mill)	Mr. S. Nutter	5	1	0	...	23·75	133
Braintree (Bocking)	S. Tabor, Esq.	12	3	6	200	27·72	135
Saffron Waldon (Wimbish)	Mrs. Emson	8	0	6	...	26·57	132
„ „ (Ashdon)	Rev. J. T. Walker	5	1	0	300	26·01	...
„ „ (Audley End)	Mr. J. Bryan	5	1	0	163	25·99	172

DIVISION IV.—EASTERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which ·01 or more fell
		Diameter.	Height Above Ground.	Height Above Sea Level	1869	
			ft. in.	feet.	inches.	
SUFFOLK.						
Nayland (Tendring Hall)	Mr. G. L. Rushmore...	8	0 8	...	26·30	137
Sudbury	J. Alexander, Esq. ...	5	3 10	116	27·39	177
Ipswich (St. Peter's)	M. Oliver, Esq.	5	1 2	17	25·51	142
Hadleigh (Aldham)	T. F. Lloyd, Esq.	5	2 6	...	27·24	167
Grundisburgh	P. Harris, Esq.	5	3 8	...	24·11	173
Saxmundham (Carlton Hall)	Mr. Clark	8	5 0	...	28·66	189
BurySt.Edmunds(DrinkstonePk)	Mr. Nichol	8	1 2	250	27·88	126
† „ „ (Abbeygate St.)	T. C. Hinnell, Esq. ...	6	35 0	...	26·70	144
† „ „ (Beech Hill)	H. Turner, Esq.....	6	0 9	...	29·99	152
† „ „ (Westley)	R. Burrell, Esq.	5	1 6	...	26·25	...
† „ „ (Barton Hall)	Mr. W. Allan.....	5	1 0	...	27·32	144
† „ „ (Culford)	Mr. P. Grieve	5	1 2	...	29·00	151
Ixworth	Rev. W. Steggall	5	1 7	...	27·96	187
„ (Walsham-le-Willows)	Miss Martineau.....	5	0 11	...	25·66	170
„ (Barningham)	J. Fison, Esq.....	8	0 10	...	22·21	...
Eye (Yaxley)	Rev. W. H. Sewell ...	8	1 0	199	25·89	187
†Lowestoft (Gisleham)	Rev. H. Jodrell.....	5	1 2	36	28·39	...
† „ (Carlton Colville)	G. Edwards, Esq. C.E.	8	0 9	6	27·84	...
† „ (Somerleyton Hall)	Mr. Rix	8	3 0	60	26·16	144
† „ („ Rectory)	Rev. C. J. Steward ...	5	0 9	56	28·16	168
NORFOLK.						
†Geldeston [Beccles]	E. T. Dowson, Esq. ...	5	1 0	30	27 63	168
„ [„]	Mrs. Farr	5	1 1	10	26·03	...
ℬ𝔄West Tofts [Brandon]	Mr. R. Martin	5	1 0	...	24·53	157
Loddon (Berghapton)	Rev. J. M. Du Port ...	...	...	...	29 32	...
Hingham	„ „ „	...	...	...	26·48	...
„ (Carleton Forehoe)	„ „ „	...	...	...	29·79	...
„ (Hardingham)	„ „ „	...	...	...	34·35	...
*DownhamMarket(OutwellSluice)	R. Lunn, Esq.	...	4 0	16	23·16	132
„ (Bexwell)	Rev. E. J. Howman...	5	0 11	...	25·50	147
„ (Fincham)	Rev. W. Blyth	3	4 0	60	26·62	...
Swaffham (Pickenham Hall)	E. A.Applewhaite,Esq	5	1 0	160 ?	26·95	169
† Norwich (St. Catherine's Close)	Mrs. Evans	5	2 3	120	29 98	149
„ (Literary Institution)	The Secretary.....	12	30 0	53	26·62	141
„ (Bethel Street)	C. M. Gibson, Esq. ...	8	0 8	90	30·46	141
† „ (Thorpe)	W. Birkbeck, Esq.....	5	1 0	137	33·00	184
Acle (Lingwood)	Mrs. Burroughes	5	2 0	...	27·76	161
†Acle	Rev. R. W. Kennion...	8	0 9	40	27·34	146
†Filby	Mr. Crisp	5	2 4	11	29·10	110
Norwich (Eaton)	J. Pymar, Esq.	6	1 0	...	31·65	...
„ (Cossey)	H. Culley, Esq.	5	1 0	...	28·23	177
† „ (Honingham Hall)	Lady Bayning	5	0 6	88	28·78	175
„ (Honingham)	Rev. J. M. Du Port ...	...	...	90	28·09	...
†Dereham (Mattishall)	„ „ „ ...	8	1 2	165	28·22	176
† „ (Hockering)	„ „ „ ...	8	1 3	140	27·76	...
ℬ𝔄*Swaffham (Grammar School)	C. J. Drury, Esq.	5	1 10	239	26·85	168
†East Dereham	G. H. Cooper, Esq. ...	8	3 0	161	29·45	...
„ „	Rev. J. M. Du Port ...	...	...	...	27·65	...

DIVISION IV.—EASTERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which ·01 or more fell.
		Diameter.	Height Above Ground.	Height Above Sea Level	1869	
			ft. in.	feet.	inches.	
NORFOLK—(*cont.*)						
Swaffham (Dunham)	Rev. J. M. Du Port	...	...	...	28·19	...
West Walton [Wisbech]	J Cross, Esq.	8	3 3	...	23·90	120
*Reepham	T. Alderton, Esq.	5	1 0	...	27·50	156
Lynn (Hillington)	Rev. H. Ffolkes	5	4 6	93	28·23	154
Fakenham (Egmere)	R. Overman, Esq.	4	4 8	150	25·12	130
Burnham (Westgate)	W. H. Spencer, Esq	3	5 10	13	26·51	152
Holkham	J. Davidson, Esq.	8	0 0	39	25 63	...
„	„ „ „	12	4 0	43	25·54	152
Wells	H. R. Rump, Esq.	5	1 0	16	26·52	204
Hunstanton	Mr. J. Rippingale	11	3 8	60	20·42	112
DIVISION V.—SOUTH-WESTERN COUNTIES.						
WILTS.						
Landford	J. R. Wigram, Esq.	5	1 6	160?	30·36	154
Salisbury (Alderbury)	Rev. R. S. Hutchings.	5	0 6	250?	29·75	135
„ (West Dean)	Rev. W. L. W. Eyre	5	1 0	139	28·96	...
„ (Wilton House)	Mr. Challis	8	0 5	150	30·30	163
„ (Woodford)	H. Hinxman, Esq.	5	1 2	150	29·56	...
„ (Baverstock)	Ven. Archdeacon Hony	12	3 0	229	27·28	...
Salisbury Plain (Chiltern Ho.)	R. Hayward, jun., Esq.	11	4 0	380	29·22	156
„ „ (Orcheston)	Rev. J. Wardale	6	0 8	240	27·70	133
„ „ (Imber)	Rev. W. Slatter	5	4 0	400?	29·88	...
Ludgershall [Andover]	E. G. Fawcett, Esq.	8	1 4	422	27·33	171
Trowbridge (Sunny Side)	W. J. Mann, Esq.	5	1 1	...	29·98	151
Bradford (Monkton Farleigh)	R. W. Caldwell, Esq.	5	1 0	580?	31·92	151
Marlborough (Kingsbury Street)	W. C. Merriman, Esq.	15	4 0	500	30·43	...
„ College	Rev. T. A. Preston	8	0 0	456	30·69	180
„ (Mildenhall)	Rev. C. Soames	5	0 10	502	30·94	171
Chippenham (Tytherton)	Major Gritton	5	1 2	150?	26·97	187
Swindon (Draycot Foliatt)	T. Arkell, Jun., Esq.	5	0 10	...	31·74	153
„ (Penhill)	T. Arkell, Esq.	5	0 10	...	31·35	153
Chippenham (Badminton)	Mr. A. McNaughten	5	0 8	...	37·46	148
DORSET.						
Weymouth (Lansdowne Villas)	E. E. Glyde, Esq.	5	1 0	110	27·57	170
Corfe Castle (West Bucknowle)	W. Voss, Esq	5	4 6	170	29·91	...
Weymouth (Osmington)	Captain Hall	5	1 0	150?	34·02	180
Upwey	J. Miller, Esq.	5	1 0	70	27·94	160
Abbotsbury	Mr. McNeil	5	3 0	150	25·71	...
*Dorchester	J. Jowett, Esq.	5	0 6	250	34·38	180
Lyme Regis	Mr. H. Tucker	5	4 6	146	33·58	182
Bridport (The Cedars)	A. Stephens, Esq.	8	0 8	60	29·97	149
Cerne Abbas (Melbury)	Mr. T. C. Elliott	12	2 9	...	37·37	...
*Wimborne Minster (Chalbury)	Rev. G. H. Billington.	5	2 0	338	29·29	163
Blandford	W. Shipp, Esq.	5	1 0	...	34·06	...
„ (Longthorns)	J. C. Mansel, Esq.	5	0 4	340	36·46	125
Shaftesbury	T. Ackland, Esq.	5	1 3	417	33·92	154
Gillingham	T. Thompson, Esq.	5	1 5	110	29·88	151

DIVISION V.—SOUTH-WESTERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground ft.	in.	Height Above Sea Level feet	Depth of Rain. 1869 inches.	Days on which ·01 or more fell.
DEVON.							
†Kingsbridge (Bolt Tail) .....(58)	W. Balkwill, Esq.....	5	1	0	297	32·97	...
† „ (Fore St. Hill) (56)	G. Fox, Esq.	5	0	6	68	38·53	152
†Plymouth (Old Town St.) ...(52)	A. P. Balkwill, Esq....	5	35	0	150	34·56	...
† „ (Navigation School)...	J. Merrifield, Esq.....	8	26	6	100	30 01	177
† „ (Saltram Gardens) (51)	Mr. J. Snow	5	0	3	96	36·30	...
† „ (Ham) .....(53)	Rev. C. T. C. Trelawny	5	3	0	94	37·82	133
†Ivybridge .....(49)	Dr. Liddell.....	10	3	0	175	46·58	...
†Brixham (Lupton) .....(48)	Mr. G. Erskine.....	12	3	2	200	40·00	140
†PlymptonStMary(Ridgew'y)(50)	Miss B. T. Phillipps ...	5	0	6	116	42·54	193
† „ „ (Hemerdon)	Rev. G. L. Woollcombe	5	0	6	...	39·05	...
⚓†Torquay (Lamorna) .....(43)	W.Pengelly,Esq,F.R.S	5	0	9	205	35·83	174
†Dartmoor (Lee Moor) .....(44)	W. L. Martin, Esq. ...	5	0	3	860	61·27	...
† „ (Redstone, Sheepstor)(41)	G. D. Bellamy, Esq....	5	0	10	800	57·12	138
†Ashburton (Druid House) ...(32)	Fabyan Amery, Esq...	5	1	0	570	?46·22	167
†Dartmoor (Prison Reservoir)(34)	Mr. H. Watts	5	0	2	1400	75·00	242
†Teignmouth (Landscore).....(29)	Mrs. Clark	5	0	3	125	25·56	...
† „ (Bishopsteignton)(30)	Rev. S. M. Scroggs ...	5	6	0	120	30·98	174
†Ilsington (Middlecott Ho.)...(23)	Alfred Lyon, Esq.....	9	3	6	639	36·12	173
†Tavistock (Public Library) (38)	Mr. W. Merrifield.....	8	20	0	283	45·39	132
† „ (West Street) .....(38)	T. Windeatt, Esq.....	1	4	6	286	48·80	...
†* „ (Mount Tavy).....(37)	H. Clark, Esq.	5	1	0	316	48·34	...
†Milton Abbot (Endsleigh) ...(26)	Mr. Cornelius.....	5	0	6	200	45·58	...
†Bovey Tracey .....(22)	J. Divett, Esq.	5	0	6	94	41·16	172
†Coryton Lew Down.....(21)	Mr. T. Symons	12	6	0	445	41·11	161
†Exmouth (Budleigh Salterton)...	R. Walker, Esq.....	5	4	0	33	28·87	156
†Chagford .....(20)	R. L. Berry, Esq.	5	0	7	575	?49·90	...
Sidmouth (Belgrave)	Dr. Mackenzie	5	0	6	26	27·73	169
„	S. Chick, Esq.	10	25	0	43	24·10	151
†Topsham (Clyst St. George)	Rev. H. T. Ellacombe.	5	1	3	76	29·79	...
†Exeter (High Street) .....(17)	W. H. Ellis, Esq.	5	47	11	184	29·93	159
† „(Devon & Exeter Institution)	Mr. E. Parfitt	6	13	7	155	32·65	136
† „ (Manston Terrace)... (18)	Miss Dymond.....	5	0	1	165	32·72	165
† „ (Brampford Speke)...(13)	W. H. Gamlen, Esq....	5	1	0	140	34·39	193
† „ „ „ (*monthly*)(13)	„ „ „ ...	8	0	2	140	35·07	...
Cullompton (Clyst Hydon)	Rev. J. Huyshe.....	...	1	0	200	31·52	...
„ (Bradninch)	H. Matthew, Esq.....	12	1	6	250	35·40	...
†Honiton (Broadhembury)	Rev. W. Heberden ...	5	1	6	400	29·98	186
*Cullompton (Strath Culm House)	C. R. Collins, Esq. ...	8	0	6	159	30·33	91
Tiverton (Cove).....(9)	W. N. Row, Esq.	11	0	4	450 ?	40·29	...
„ (Springfield)	H. Stokes, Esq.....	6	0	3	300 ?	40·68	210
Chulmleigh (Witheridge).....(8)	Rev. J. P. Benson.....	...	...		...	34·97	156
Great Torrington	Rev. S. Buckland	5	1	1	321	42·39	179
S. Molton (Meshaw)	Rev. W. H. Karslake	8	0	6	472	38·68	196
Bampton .....(6)	J. Edwards, Esq.	5	1	0	400	40·87	207
*Bideford (Buckish) .....(7)	Rev. J. H. Kirwan ...	5	1	1	550	48·09	208
* „ (Northam) .....(5)	Rev. I. H. Gosset	5	1	0	173	36·44	190
S. Molton (Castle Hill).....(4)	Mr. J. Baillie.....	12	3	5	200	48·43	171
Barnstaple .....(3)	T. Mackrell, Esq.	8	0	6	31	39·72	189

NOTE.—The figures in parentheses on this and the following page correspond to those on the Map facing page 46.

DIVISION V.—SOUTH-WESTERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Rain Gauge. Height Above Ground.	Rain Gauge. Height Above Sea Level	Depth of Rain. 1869	Days on which ·01 or more fell.
			ft. in.	feet.	inches.	
CORNWALL.						
†Land's End (St. Sennen)	Rev. G. L. Woollcombe	5	4 10	290	24·42	181
†Helstone	M. P. Moyle, Esq.	5	5 0	115	32·60	197
† „ (Antron Lodge)	Rev. H. J. A. Fothergill	5	5 11	235	37·32	200
†Penzance	W. H. Richards, Esq.	12	3 0	94	39·02	...
†Redruth (Tehidy Park)	Mr. Mills	5	0 6	100	36·86	...
†Truro (Royal Institution)	Dr. Barham	10	40 0	56	37·82	202
† „ (Penarth)	N. Whitley, Esq.	12	1 0	190	35·90	184
† „ (Strangways Terrace)	Dr. Barham	8	2 6	71	38·39	205
†St. Agnes	Mr. Opie	11	1 0	278	38·71	178
†*St. Austell (Trevarna)	W. Coode, Esq.	5	0 6	300	41·85	175
„ (Trevarrick)	C. Truscott, Jun., Esq.	5	1 0	169	44·86	210
„ (Polcarne)	J. Coode, Esq.	5	1 2	206	38·83	123
†Menhenniot (Catchfrench) (55)	Miss C. Glanville	8	0 6	270	44·17	...
†Newquay	Mr. W. H. Tregidgo	6	1 9	90	33·47	144
†Liskeard (Dean Terrace) (47)	S. W. Jenkin, Esq. C.E.	5	1 1	375	46·17	202
†Callington (Pentillie Castle) (46)	Mr. C. Edwards	5	1 5	150	48·21	170
† „ (Hingston Down) (39)	Captain Richards	11	1 0	850	63·48	182
† „ (Church Street) (40)	Mr. J. Brown, Jun.	5	3 0	490	54·12	193
†Bodmin (Castle Street)	Capt. Liddell, R.N.	8	2 6	338	43·44	...
† „ „ „	„ „	5	1 0	338	44·44	216
† „ „ „ *weekly*	„ „	5	0 1	338	45·63	..
† „ (Fore Street)	A. Hambly, Esq.	8	2 6	336	43·40	217
† „ (Warleggan)	Rev. D. Clements	8	2 6	550	52·28	167
†Wadebridge	Mr. C. Jordan	8	2 6	23	34·45	156
† „ (Treglines, St. Minver)	Mr. T. Liddell, Jun.	10	3 0	140	32·04	179
† „ (Treharrock House)	F. B. Hambly, Esq.	5	2 9	303	36·29	193
†St. Endellion (Park Villa)	Miss Guy	8	3 0	277	30·58	154
†Launceston (Altarnum) (28)	C. U. Tripp, Esq.	5	0 10	570	60·52	213
† „ (Hexworthy) (27)	H. M. Harvey, Esq.	5	1 1	410	46·22	150
SOMERSET.						
Crewkerne (Bincombe House)	F. J. Sparkes, Esq.	5	1 2	250?	34·13	163
Ilminster	J. Knott, Esq.	5	0 10	131	32·03	171
„ (South Petherton)	W. Blake, Esq.	8	0 6	200?	27·21	161
Ilebrewers (Walrond Park)	J. Ostler, Jun., Esq.	5	1 0	116	27·52	104
Ilchester	J. W. Bourne, Esq.	8	2 0	40?	28·77	125
*Wellington (Sunnyside)	W. Elworthy, Esq.	5	1 0	...	31·09	159
*Taunton (Fullands School)	W. Reed, Esq.	5	1 4	...	25·01	122
„ (College School)	Rev. W. Tuckwell	5	1 0	48	28·65	157
„ (The Mount)	H. Alford, Esq.	4	1 2	...	29·49	190
„ (The Castle)	G. Gillett, Esq.	8	1 6	...	26·87	164
Langport (Long Sutton)	R. Palmer, Esq.	5	0 10	50	27·46	144
*Wiveliscombe	B. Boucher, Esq.	5	1 2	...	32·93	178
Quantock Hills (Bagborough)	Rev. J. B. Rikey	9	3 0	1000?	25·86	...
Glastonbury (Street)	W. S. Clark, Esq.	8	1 0	60	30·38	171
Wells (Dinder)	Rev. T. J. Bumpsted	8	4 0	140?	?45·45	164
Burnham (The Colony)	Captain Estlin	5	1 0	30	28·12	152
Frome (Mells Rectory)	Rev. J. H. Horner.	5	1 0	342	39·81	192
E. Harptree (Sherborne Reservoir)	Bristol Water Works	5	1 0	338	49·41	...

DIVISION V.—SOUTH-WESTERN COUNTIES—(*continued*).

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground.	Height above Sea Level	Depth of Rain. 1869	Days on which ·01 or more fell.
			ft. in.	feet.	inches.	
SOMERSET—(*con.*)						
Chew Magna [Bristol]	Bristol Water Works...	5	1 0	160	35·15	...
West Harptree Vicarage	Rev. Dr. Tyas	...	0 5	237	43·84	180
Bath (Paragon)	Dr. Barter	5	1 3	126	32·28	168
„ (Literary Institute)	C. P. Russell, Esq.	5	8 0	75	31·69	162
„ (Weston)		5	0 10	190	31·03	180
„ (Batheaston, Bannerdown Ho.)	Colonel Ward	5	1 0	250	33·94	163
„ „ Reservoir)	A. Mitchell, Esq.	12	2 0	226	29·26	136
Chelvey [Bristol]	Rev. J. Matthew	5	0 5	37	32·37	160
Barrow Gurney Reservoir	Bristol Water Works	5	1 0	320	40·86	...

DIVISION VI.—WEST MIDLAND COUNTIES.

GLOUCESTER.						
Bristol (Small St.)	Bristol Water Works	5	25 0	40	34·36	...
„ (Phil. Inst.)	B. Wright, Esq.	...	...	...	33·67	142
„ (Montpelier)	F. P. Bisson, Esq.	5	2 0	100	35·78	181
„ (Over Court)	R.C.C. Lippincott, Esq.	8	0 8	148?	34·90	177
Clifton (South Parade)	Dr. G. F. Burder	8	0 6	192	36·17	...
„ (Royal York Crescent)	A. North, Esq.	12	1 0	197	35·96	161
„ („ „ „)	„ „ „	5	1 0	197	35·51	160
Fairford (Kempsford)	R. A. Iles, Esq.	5	0 8	...	29·85	145
Nailsworth (Spring Hill)	H. D. Humphries, Esq.	8	2 0	...	38·76	182
Berkeley (Estate Offices)	J. H. Cooke, Esq.	5	8 0	60	29·28	139
Lydney	Rev. W. H. Bathurst.	8	1 0	30	40·22	...
Cirencester (The Firs)	J. Bravender, Esq.	5	0 8	350	33·75	173
„ (Further Barton)	T. C. Brown, Esq.	10	1 2	446	36·53	...
Fairford (Hatherop)	W. Arkell, Esq.	5	...	...	32·99	120
Stroud (Upfield)	Miss Stanton	5	0 11	170?	31·55	...
„ (Castle Villas)	J. Bateman, Esq.	...	1 0	240	35·02	176
Frampton-on-Severn (Saul Lodge)	W.B.Clegram, Esq.C.E.	5	3 6	42	30·28	157
Northleach (Yanworth)	W. Arkell, Esq.	5	1 0	...	35·37	...
Cheltenham (Cowley Manor)	Mr. J. Sadler	...	1 4	600	38·24	178
Gloucester (Witcomb Court)	A. Bubb, Esq.	8	2 0	225	29·99	...
„ („ Water Works	T. Small, Esq.	8	3 0	297	31·67	123
„ (Quedgeley Ho.)	J. C. Hayward, Esq.	5	0 10	50	33·69	...
„ (Barnwood Ho.)	Dr. A. J. Wood	8	3 6	60?	31·17	131
„ (Park House)	Alfred Price, Esq.	5	3 6	50	29·04	...
„ (County Asylum)	Dr. Toller	8	0 4	100	30·43	...
Cheltenham (Keynsham Bank)	H. D. Humphries, Esq.	8	6 6	232	31·00	141
„ (Hatherley Sew. Wks.)	„ „ „	8	16 6	172	22·58	146
„ (Arle=Chelt „ „)	„ „ „	8	16 6	169	22·28	147
Newent (Boyce Court)	General Drummond	8	1 3	133	31·78	149
Moreton-in-Marsh (Frogmore)	W. Arkell, Jun., Esq.	5	0 10	...	29·19	159
HEREFORD.						
Ross (Rocklands)	J. M. Herbert, Esq.	8	1 10	140?	38·13	145
Ross	H. Southall, Esq.	5	1 4	280	33·25	164
„ (Sellack Vicarage)	Rev. W. C. Ley	...	...	...	32·15	142

DIVISION VI.—WEST MIDLAND COUNTIES.—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground.	Height Above Sea Level	Depth of Rain. 1869	Days on which ·01 or more fell.
			ft. in.	feet	inches.	
HEREFORD—(*con.*)						
Hereford (Fownhope Vicarage	Rev. T. West	5	1 1	...	31·76	...
„ (Broomy Hill)	T. Curley, Esq., C.E	5	0 11	215	32·76	196
„ (Blue Coat School)	W. Cooke, Esq.	8	6 0	188	28·21	118
„ (Richmond Place)	E. J. Isbell, Esq.	8	5 8	188	30·96	193
„ (Davison's Nursery)	„ „ „	8	1 0	192	32·22	193
„ (Hagley Park)	A. Hutchinson, Esq.	5	0 6	280?	28·12	...
„ (Tupsley)	P. Ballard, Esq.	5	1 1	...	30·68	...
„ (Stretton)	Rev H. C. Key	5	1 0	190	30·48	145
Kington (The Moor)	S. Robinson, Esq.	8	1 0	...	32·49	...
Leominster (West Lodge)	E. P. Southall, Esq.	5	1 3	250	29·49	171
Kington (Burcher Cottage)	Miss Boddington	12	2 8	...	33·99	147
Leominster (Leysters)	Rev. T. S. Hewitt	5	0 4	600?	28·68	126
SHROPSHIRE.						
Burford [Tenbury]	Lord Northwick	5	1 0	100?	30·78	...
Ludlow (Knowbury)	Rev. J. B. James	5	0 11	1000?	30·02	...
„ (Mill Street)	W. Marston, Esq.	5	1 1	337	32·88	173
Bridgenorth (Quatt School)	Mr. L. Roach	5	4 2	190	26·59	145
Church Stretton (Woolstaston)	Rev. D. Carr	5	1 0	790	33·26	187
Shiffnal (Badger)	Rev. T. F. Boddington	5	3 3	..	27·89	147
„ (Haughton Hall)	Rev. J. Brooke	5	3 6	353	27·97	173
Shrewsbury	Marshall & Co.	10	4 4	192	24·65	103
„ (Monkmoor)	Miss Lovett	5	1 0	200	27·95	186
„ (Fitz Manor)	R. Middleton, Esq.	5	2 9	287	26·12	...
Newport	J. Bodenham, Esq.	5	1 0	250	31·29	191
Oswestry (Hengoed)	Rev. A. R. Lloyd	5	6 0	471	38·01	...
Market Drayton (Nort'n-in-Hales)	Rev. F. Silver	8	0 6	335	27·35	119
„ (Adderley)	Rev. Athelstan Corbet	5	0 9	245	30·08	174
BA* Whitchurch	A. B. George, Esq.	5	3 0	...	32·87	162
STAFFORD.						
Wolverhampton (Oaklands)	H. Ward, Esq.	5	0 10	526	32·31	152
„ (Waterloo Road)	C. G. DeLessert, Esq.	5	1 1	500	30·21	152
„ (Wadham's Hill)	Rev. E. W. Winter	8	4 0	450	28·52	...
„ (Pattingham)	Rev. B. S. Malden	5	1 3	400	27·93	...
„ (Wrottesley) *monthly*	J. Hough, Esq.	8	0 8	490	28·14	...
Weston-under-Lyziard [Shiffnal]	Hon. Rev. J. Bridgeman	3	0 10	..	28·54	188
Burton-on-Trent	J. Matthews, Esq.	5	3 0	152	28·14	166
„ (Horninglow)	R. W. Abbotts, Esq.	5	4 0	150	28·90	172
Stoke (Barlaston)	W. Scott, Esq.	5	0 6	530	34·15	185
Oakmoor (Ellaston)	Rev Sir C. R Lighton, Bt.	5	3 0	400	35·16	181
Stoke (Stanley Reservoir)	J. Forbes, Esq., C.E.	5	3 1	550	32·10	158
„ (Etruria)	„	5	4 2	440	35·06	187
Leek (Rudyard)	„	5	12 7	500	33·55	153
Knypersley [Congleton]	„	5	14 0	500	35·80	187
Wincle [Macclesfield]	„	5	5 0	500	35·42	160
WORCESTER.						
Northwick Park	Lord Northwick	8	1 0	...	30·72	...
Evesham (Lansdowne)	R. Burlingham, Esq.	8	4 6	124	27·29	159
Great Malvern	Messrs. W. & J. Burrow	5	0 10	522	34·09	172

DIVISION VI.—WEST MIDLAND COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground.	Height Above SeaLevel	Depth of Rain. 1869	Days on which .01 or more fell.
			ft. in.	feet.	inches.	
WORCESTER—(*con.*)						
West Malvern	A. H. Hartland, Esq.	8	1 6	900	33·68	...
Worcester (Lark Hill)	W. Burgess, Esq.	5	1 0	157	30·55	153
„ (Gas Works)	F. N. Gosling, Esq.	10	4 1	...	26·09	...
Tenbury (Orleton)	T. H. Davis, Esq.	5	0 9	200	33·81	184
Bromsgrove (The Ford House)	G. Dipple, Esq.	11	4 4	273	31·00	160
Kidderminster (Churchill Court	W. Hartley King, Esq.	8	0 6	...	26·21	...
Stourbridge (Hagley Rectory)	Hon. Mrs. Lyttleton	8	0 5	636	34·17	164
„ (Dunsley)	J. Bourn, Esq.	5	0 10	302	28·57	160
Moseley [Birmingham]	T. L. Plant, Esq.	5	4 0	487	33·07	183
WARWICK.						
Alcester (Sambourne)	A. Winkfield, Esq.	5	1 3	...	29·21	...
Henley-in-Arden (Arden House)	G. R. Dartnell, Esq.	5	2 0	400	25·67	141
Leamington (Upper Parade)	S. U. Jones, Esq.	5	0 8	195	23·63	156
Coventry	J. Gulson, Esq.	8	...	...	27·35	...
„ (Radford)	Miss Atkins	8	1 0	305	24·42	161
Pailton House [Lutterworth]	Capt. Constable Curtis	5	1 0	...	25·75	167
†Birmingham (Edgbaston)	Miss R. B. Southall	8	1 3	510	31·02	180
„ (Botanic Garden)	Mr. Latham	5	5 2	...	29·17	189
† „ (Bloomsbury Street)	D. Smith, Esq.	8	0 10	340	31·46	171

DIVISION VII.—NORTH MIDLAND COUNTIES.

LEICESTER.						
Knaptoft Hall [Rugby]	T. Willson, Esq.	5	1 6	...	24·91	...
†Market Harborough (Fleckney)	J. B. Putt, Esq.	5	0 8	411	24·73	...
Hinckley (Stretton Fields)	T. J. Scott, Esq.	5	0 6	...	25·47	180
†Wigston	T. Burgess, Esq.	8	0 6	220	26·70	138
Leicester	H. Billson, Esq.	8	0 6	130	28·04	150
†Thornton Reservoir	J. Bevins, Esq.	10	2 8	420?	28·07	157
Appleby	Rev. F. B. Falkner	5	1 0	335	28·74	...
†Owston [Oakham]	Miss Gilford	5	1 0	580	27·69	167
Melton Mowbray (Dalby Hall)	Mr. G. Jones	8	2 6	480?	26·12	168
„ „ (Asfordby)	Rev. C. A. Holmes	5	0 11	212	25·87	151
Loughborough (Cedar Cottage)	J. Giles, Esq.	5	0 9	400	28·00	...
Waltham Rectory	Rev. G. E. Gillett	8	0 8	560	28·84	173
†Belvoir Castle	W. Ingram, Esq.	8	1 0	237	29·01	161
RUTLAND.						
Uppingham (Wing Rectory)	Rev. Herbert A. Boys	4	0 7	400?	?26·82	165
Tickencote Warren	Rev. C. L. Wingfield	8	2 0	...	24·77	136
Ryhall	Rev. C. Potchett	...	...	...	24·42	136
LINCOLN.						
*Bourne (Wytham-on-the-Hill)	A. C. Johnson, Esq.	5	1 3	167?	23·03	153
Grantham (Denton Hall)	Sir Welby-Gregory, Bt.	8	2 0	200	25·26	...
† „	J. W. Jeans, Esq.	8	0 6	179	26·78	163
Sleaford (Heydour)	Rev. G. F. Deedes	5	2 6	...	25·91	89
„ (Aswarby)	Rev. C. Whichcote	5	4 0	...	24·21	...
Boston (Bargate Lodge)	Dr. Mercer Adam	5	1 0	20	27 53	194
„ (Grand Sluice)	„ „ „	8	8 0	20	24·78	172

DIVISION VII.—NORTH-MIDLAND COUNTIES—(*continued*).

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground.	Height Above Sea Level	Depth of Rain. 1869	Days on which ·01 or more fell.
			ft. in.	feet.	inches.	
LINCOLN—(*con.*)						
Boston (Pen Street)	W.H.Wheeler Esq.C.E	8	5 0	20	27·26	184
Stubton [Newark]	G. Nevile, Esq.	5	4 6	...	27·55	149
Lincoln (Navenby)	Rev. J. Hays	...	...	...	28·77	...
Horncastle (Miningsley)	W.H.Wheeler,Esq,C.E	8	0 6	160	27·55	152
Spilsby (Welton-le-Marsh)	Rev. A. Wright	5	3 6	180?	27·61	124
Lincoln (Branston)	A.S.LeslieMelville,Esq	5	0 9	...	28·78	162
„	M. S. & L. R. Co ‡	9	3 6	26	24·10	143
Gate Burton	„ „ „	9	3 6	96	28·24	170
Louth	T. W. Wallis, Esq.	3	5 0	80	31·28	194
Market Rasen	M. S. & L. R. Co.	9	3 6	100	25·88	189
Gainsborough	„ „ „	9	3 6	76	25·25	143
Stockwith	„ „ „	9	3 6	21	22·40	122
Brigg	„ „ „	9	3 6	16	24·77	150
Grimsby	„ „ „	9	15 0	42	26·00	168
Barnetby	„ „ „	9	3 6	51	27·42	158
Crowle (Keadby)	„ „ „	...	...	10	27·36	148
Ulceby (Killingholme)	Rev. J. Byron	5	1 4	60	30·61	203
Brigg (Appleby)	Rev. J. E. Cross	5	0 9	60	25·03	...
„ (Ferriby Sluice)	„ „ „	5	0 9	10	23·80	...
New Holland	M. S. & . R. Co.	9	3 6	18	23·31	175
NOTTS.						
Nottingham(RuddingtonGrange)	C. Paget, Esq	8	1 1	...	25·96	182
„ Park	Mr. W. Chapman	5	1 3	80	27·76	...
„ (Arboretum)	M O.TarbottonEsqC.E	8	0 5	238	27·75	165
„ „ „	„ „ „	8	25 6	263	26·62	...
Southwell (Oxton)	H. Sherbrooke, Esq.	2	2 0	...	29·85	...
„	W. W. P. Clay, Esq.	6	1 0	200	23·90	...
Ollerton (Edwinstowe)	W. Horncastle, Esq.	12	...	...	27·49	...
Welbeck Abbey	Mr. W. Tillery	5	3 0	80	26·50	129
Worksop	M. S. & L. R. Co.	9	3 6	127	23·75	168
Retford	„ „ „	9	3 6	52	23·01	105
DERBY.						
Sawley	Mr. J. Windle	5	0 9	100	27·99	...
Trent College	C. U. Tripp, Esq.	5	0 10	150?	25·70	180
Derby	J. Davis, Esq.	5	6 0	180	27·35	185
„ (Morley)	Rev. S. Fox	5	3 0	406	30·07	176
„ (West Hallam)	Rev. C. J. Newdigate	5	2 0	356	28·92	177
„ (Duffield)	W. Bland, Esq.	5	0 10	200?	29·97	150
Belper	J. G. Jackson, Esq.	5	0 8	240	30·26	177
Matlock Bath	R. Chadwick, Esq.	5	1 6	500?	35·60	...
Chesterfield	M. S. & L. R. Co.	9	3 6	248	27·53	119
Brampton (Fairfield)	J. M. Hewitt, Esq.	5	6 8	510	33·14	205
„ (St. Thomas')	Rev. J. M. Mello	5	6 6	326	29·80	159
Chatsworth Gardens	Mr. Speed	12	0 6	...	30·04	...
Buxton (Axe Edge)	E. J. Sykes, Esq.	8	1 0	1721	47·45	...
„ (Devonshire Hospital)	„ „ „	8	5 0	1040	54·06	209

‡ Kept for the Canals Department of the Manchester, Sheffield, and Lincolnshire Railway Company. Returns supplied by R. D. Heathcote, Esq.

DIVISION VII.—NORTH MIDLAND COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground.	Height Above Sea Level	Depth of Rain. 1869	Days on which .10 or more fell.
			ft. in.	feet.	inches.	
DERBY—(*con.*)						
Stony Middleton	Rev. U. Smith	5	4 0	640?	36·00	166
Norwood	M. S. & L. R. Co.	9	3 6	238	24·91	173
Comb's Moss	„ „ „	9	3 6	1669	49·50	...
„ Reservoir	„ „ „	9	3 6	710	48·42	217
†Chapel-en-le-Frith	„ „ „	9	3 6	965	42·82	196
†Woodhead	„ „ „	9	3 6	878	54·59	188

DIVISION VIII.—NORTH-WESTERN COUNTIES.

CHESHIRE.							
Nantwich (Cholmondelly Cas.)	E.L.Williams,Esq.C.E.	8	1 6	42	34·23	180
Chester (Pulford Hall)	R. Massie, Esq.	5	4 0	60	26·41	179
Bosley Minns	M. S. & L. R. Co.	9	3 6	1210	35·48	134
„ Reservoir	„ „ „	9	3 6	590	32·22	155
Chester (Crane Street)	F.Hardacre, Esq., C.E.	5	1 6	20	28·21	...
„ (Hole Bank)	F. G. Tippinge, Esq.	...	...	53?	28·23	...
Macclesfield	M. S. & L. R. Co.	9	3 6	539	39·69	161
„ (Park Green)	W. Jeffery, Esq.	8	2 1	450	36·86	194
„ (Town Yard)	H. S. Aspinwall, Esq.	8	1 11	425	37·62	206
Chelford	Mr. C. Nichols	5	1 6	...	35·21	161
Northwich	E.L.Williams,Esq.C.E.	8	1 6	65	33·85	191
Neston (Hinderton)	Reginald Bushell, Esq.	5	1 0	195	28·56	188
Runcorn (Weston Point)	E.L.Williams,Esq.C.E.	5	1 0	15	32·21	202
Bollington (Spond's Hill)	M. S. & L. R. Co.	9	3 6	1279	36·64	...
Whaley	„ „ „	9	3 6	602	45·87	216
Altrincham (Barrington House)	J. Newton, Esq., C.E.	5	1 0	105	38·70	...
Birkenhead (Bidstone Obs.)	J. Hartnup, Esq.	8	0 6	182	29·81	180
„ (Wallasea)	W. Bouch, Esq.	5	0 4	19	38·85	219
„ (New Brighton)	„ „ „	5	1 2	130	32·22	194
Warburton [Warrington]	Rev. D. A. Beaufort	8	0 11	20	33·85	...
Marple Aqueduct	M. S. & L. R. Co.	9	3 6	321	35·42	169
„ Top Lock	„ „ „	9	3 6	543	35·65	173
Stockport (Wellington Road)	G. H. Gaskell, Esq.	...	...	...	26 38	183
Godley Reservoir	J.F.Bateman,Esq.FRS	...	...	500	35·66	...
Mottram Hill End	M. S. & L. R. Co.	9	3 6	680	42·01	192
„ Matley's Field	„ „ „	9	3 6	399	39·44	192
Newton	„ „ „	9	3 6	396	31·81	133
Arnfield Reservoir	J.F.Bateman,Esq.FRS	...	..	575	40·05	...
Staleybridge (Swineshaw)	Mr. W. Watts	9	3 0	884	45·30	184
†Rhodes Wood Reservoir	J.F.Bateman,Esq.FRS	12	1 0	520	49·16	...
†Woodhead „	„ „ „	12	0 10	680	59·12	...
†Torrside „	„ „ „	12	1 6	600	50·93	...
LANCASHIRE.						
Warrington (Penketh)	L. W. Reynolds, Esq.	8	1 0	39	31·45	191
West Derby (Sandfield Park)	Mr. W. Biggs	8	1 2	147	35·02	175
Denton Reservoir	J.F.Bateman,Esq. FRS	...	..	324	33·24	...
Gorton „	„ „ „	...	...	263	33·75	...

DIVISION VIII.—NORTH WESTERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter	Height Above Ground.	Height Above Sea Level	Depth of Rain. 1869	Days on which ·01 or more fell.
			ft in.	feet.	inches.	
LANCASHIRE—(*con.*)						
†Manchester (Old Trafford)	G. V. Vernon, Esq. ...	8	2 7	106	35·45	187
† „ „ „	J. Curtis, Esq.	8	2 3	111	34·80	185
„ (Plymouth Grove)...	J. F. Roberts, Esq.....	8	3 9	150	35·02	185
„ (Eccles)	T. Mackereth, Esq.....	10	3 0	145	35·70	210
„ „	„ „ „	5	34 0	179	28·63	210
Salford (Town Hall)	„ „ „	5	7 0	115	33·77	203
Manchester (Ardwick)	J. Casartelli, Esq.....	9	3 0	160	33·10	182
† „ (Piccadilly)	M. S. & L. R. Co.....	9	40 0	194	35·14	190
Fairfield	„ „ „	9	6 0	312	39·91	202
Stoneclough (Outwood).....	W. Horrocks, Esq. ...	12	1 0	295	40·75	184
Wigan (Water Works)	J. L. Hunter, Esq., C.E.	6	0 9	228	40·52	189
Oldham (Waterhouses)	M. S. & L. R. Co.....	9	3 6	345	36·86	172
„ (Gas Works).....	J. Taylor, Esq.	9	6 0	600	37·60	198
„ (Strines Dale)	„ „ „	10	6 0	800	35·43	215
„ (Brushes Clough)	„ „ „	10	6 0	950	45·04	223
„ (Picthorne)	„ „ „	10	6 0	800	36·35	216
63 *Oldham (Royton)	Mr. B. K. Bentley ...	5	4 0	544	41·39	163
Radcliffe (Mount Sion)	H. Eaton, Esq.	10	1 3	200	40·50	...
Bolton-le-Moors (The Folds).....	H. H. Watson, Esq....	10	3 6	286	49·00	...
„ (Vale Bank).....	J. Watkins, Esq.	5	3 0	300	45·83	176
„ (Moss Bank) ...	R. H. Ainsworth, Esq.	...	1 2	...	55·62	...
„ (Heaton)	H. Baylis, Esq.	10	0 0	500	45·20	161
„ „	J. S. Holdsworth, Esq	10	3 6	497	45 07	197
„ (Belmont)	H. Baylis, Esq.	10	0 0	800	58·40	162
Entwistle.....	„ „ „	.	0 0	700	58·10	169
Rochdale (Nagden Dane).....	C. E. Cawley, Esq. M.P.	5	1 6	900	42·13	...
Ormskirk (Rufford)	J. Porter, Esq.	5	0 8	38	35·93	185
Rawtenstall (Hapton Reservoir)	E. Barber, Esq.....	8	1 0	900	51·80	171
Blackburn (W. Works Office)....	J. F. Bateman, Esq. FRS	...	...	400	45·60	...
„ (Pickup Reservoir) ...	„ „ „	...	...	720	46·60	...
„ (Guide Reservoir) ...	„ „ „	...	...	650	43·20	...
„ (Audley Place).....	J. Shackleton, Esq. ...	5	0 6	450	49·99	199
Burnley W. Works (Swindon)...	J. Emmett, Esq.	...	18 0	750	40·27	...
Preston (Howick House) *old gauge*	T. Norris, Esq.	12	0 6	73	41·00	...
„ „ (*new gauge*)	„ „ „	12	0 6	73	40·20	...
„ (Fishwick).....	T. Oddie, Esq.	7	24 0	154	41·52	...
„ (Atherton Terrace)	J. Armytage, Esq., C E.	8	1 2	143	44·77	...
Blackpool (South Shore)	G. Sharples, Esq.	10	1 8	29	32·29	...
Stonyhurst College	Rev. S. J. Perry	11	0 8	374	54·44	195
Preston W. Works. Alston	J. Armytage, Esq., C.E.	8	1 2	320	50·03	...
Knowl Green	„ „	8	1 2	400	41·68	...
Jeffrey Hill	„ „	8	1 2	900	44·38	...
Londscales	„ „	8	1 2	400	44·44	...
Spade Mill	„ „	8	1 2	400	47·28	...
Clitheroe (Bashall Lodge).....	W. Garnett, Esq.	...	...	...	57·66	...
„ (Knowlemere Manor)..	J. Peel, Esq.	...	1 0	432	62·32	...
„ (Downham Hall)	R. Assheton, Esq. M.P	10	1 6	464	48·54	...
Garstang (Vale House)	J. Jackson, Junr., Esq.	6	4 3	455	47·81	193

DIVISION VIII.—NORTH-WESTERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground.	Height Above Sea Level	Depth of Rain. 1869	Days on which ·01 or more fell.
			ft. in.	feet.	inches.	
LANCASHIRE—(*con.*)						
Garstang (Grizedale)	J. Bradley, Esq.	8	1 0	438	51·70	...
Lancaster (South Road)	W. Roper, Esq.	12	3 6	118	41·90	189
† ,, (Caton)	Rev. A. Christopherson	5	1 9	120	44·90	175
Hest Bank	T. Ransome, Esq.	12	2 2	58	39·65	...
Melling (Hornby Castle)	Mr. Reid	12	3 2	103	50·14	166
,, (Storr's Hall)	F. F. Pearson, Esq.	5	1 0	220	49·65	...
Yealand Conyers [Milnthorpe]	Rev. T. Birkett	5	3 0	225	44·20	161
Silverdale [Milnthorpe]	C.C.W.Shepheard,Esq.	5	1 0	56	41·88	...
Leck Hall [Kirkby Lonsdale]	H. T. Welch, Esq.	5	1 3	498	56·19	...
† Cartmel (Allithwaite)	Mr. W. R. Nash	5	1 0	88	43·11	194
† ,, (Holker)	Mr. Wilson	8	4 8	155	48·23	215
‡ *Ulverston	J. H. Matthews, Esq.	5	5 6	162	52·53	204
† Grange (Broughton Hall)	Captain Ainsworth	5	2 8	230	52·65	196
Coniston (Lanehead)	R. J. Bywater, Esq.	5	1 0	287	80·06	201
† ,, (Waterhead House)	J. G. Marshall, Esq.	10	4 11	150	77·90	...

DIVISION IX.—YORKSHIRE.

WEST RIDING.						
Sheffield (Station)	M. S. & L. R. Co.	9	3 6	188	26·31	188
,, (Edge)	,, ,, ,,	9	3 6	336	34·61	196
,, (Broomhall Park)	D. Doncaster, Jun. Esq	10	2 0	337	30·79	196
,, (High Hazles)	Mrs. Hounsfield	9	3 0	280	26·43	165
,, (Walkley) ..... *monthly*	D.Doncaster,Jun., Esq.	10	0 6	...	33·98	...
† Redmires	J. Gunson, Esq.	10	4 0	1100	43·90	...
Tickhill	Dr. Dixon	8	2 0	61	25·38	172
Rotherham	M. S. & L. R. Co.	9	...	85	25·89	139
† ,, (Moorgate Grove)	R. Chrimes, Esq.	5	1 0	262	26·02	170
,, (Masboro' Vicarage)	Rev. H. Masters White	5	1 0	125	25·19	170
,, (Wath-upon-Dearne)	W. M Burman, Esq.	8	6 6	186	23·40	160
,, (West Melton)	Rev. J. Boyd	6	0 10	172	25·81	169
Doncaster	M. S. & L. R. Co.	9	...	35	25·69	174
,, (Magdalens)	Mr. J. Howorth	5	5 9	46	25·62	110
† Dunford Bridge	M. S. & L. R. Co.	9	3 6	954	68·06	210
† ,, (Reservoir)	Mr. G. Whitfield	12	2 0	1100	56·11	...
† Penistone	M. S. & L. R. Co.	9	3 6	717	34·03	184
† Carlcotes	,, ,, ,,	9	3 6	1075	62·68	184
Barnsley (Elsecar)	,, ,, ,,	9	...	175	26·34	175
,, (Worsborough)	,, ,, ,,	9	...	225	25·73	182
,,	,, ,, ,,	9	...	175	25·73	148
,, (Church Street)	Dr. Sadler	5	3 10	350	27·40	195
† Holmfirth(HolmeStyesReservoir)	J.F.Bateman, Esq.FRS	7	2 0	850	38·00	...
† ,, (Boshaw Whams Reservoir)	,, ,, ,,	7	1 9	950	31·80	...
† ,, (Bilberry Reservoir)	,, ,, ,,	8	1 6	800	48·00	...
† Saddleworth (Friesland)	G. Venables, Esq.	5	3 6	630	48·16	...
† ,, (Station)	E. Greenwood, Esq.	10	5 0	640	45·08	...
† Standedge	,, ,, ,,	8	2 0	1150	57·25	...
Ackworth School	G. Satterthwaite, Esq.	5	0 3	135	24·68	154

DIVISION IX.—YORKSHIRE—(*continued*).

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground.	Height Above Sea Level	Depth of Rain 1869	Days on which ·01 or more fell.
			ft. in.	feet.	inches.	
WEST RIDING—(*con.*)						
Snaith (Balne Vicarage)	Rev. T. S. Ackland	5	1 0	25	26·87	...
Goole	T. Kendall, Esq.	11	3 4	...	30·07	193
† Meltham (Harden Moss)	C. K. Hare, Esq.	8	1 0	1200	53·72	...
† „ (Grange)	„ „ „	8	1 0	930	46·20	...
Golcar	J. E. Ramsden, Esq.	...	1 6	400	47·55	...
† Huddersfield (Longwood)	C. K. Hare, Esq.	10	4 6	650	36·88	207
„ („ Bilberry Edge)	„ „	8	1 0	1100	41·14	...
† „ (Fartown)	Captain Chichester	5	1 6	300	35·54	209
† „ (Dalton)	J. W. Robson, Esq.	5	0 6	350	34·47	175
† „ „	„ „	8	0 6	350	34·28	175
„ (Nortonthorpe)	A. M. Box, Esq.	3	0 3	475	?34·13	200
Mirfield (Cote Wall)	E. B. W. Balme, Esq.	8	0 9	200	27·04	129
Todmorden (Stansfield Hall)	J. Fielden, Esq., M.P.	8	12 4	500 ?	39·53	204
*Huddersfield (Rastrick)	A. Clay, Esq.	5	1 3	410	30·58	180
Halifax (Willow Hall Observa.)	Louis J. Crossley, Esq.	8	0 5	630	40·70	167
„ (Warley Moor)	J. F. Bateman, Esq, FRS	...	...	1425	44·80	...
† „ (Well Head) *monthly*	J Waterhouse, Esq. FRS	12	0 11	487	37·86	...
„ („) *(daily)*	„ „ „	7	1 0	527	40·37	186
„ (Midgley Moor)	J. F. Bateman, Esq, FRS	...	...	1350	50·50	...
„ (Ovendon Moor)	„ „	...	...	1375	44·70	...
„ (Walshaw Dean)	„ „	...	...	1380	50·40	...
Bradford (Mechanics' Institute)	C. Lund, Esq.	8	48 0	373	35·01	202
„ (Manywells-Hewenden)	C. Gott, Esq., C.E.	5	0 9	700	34·03	181
„ (Chellow Dean)	„ „	10	5 0	650	34·40	130
„ (Doe Park)	„ „	8	0 9	810	47·32	192
„ (Queensbury)	W. Foster, Esq.	5	5 4	1050	38·50	122
Leeds (Leventhorpe Hall)	J. T. Leather, Esq. C.E	10	2 0	90	24·02	...
† „ (Holbeck)	Messrs. Marshall & Co.	10	32 0	127	21·05	131
„ („)	„ „ „	5	1 0	95	24·78	172
„ („ W. Works Depot)	E. Filliter, Esq, C.E.	8	1 3	95	27·08	180
„ (Philos. Hall)	H. Denny, Esq.	10	48 0	137	24·09	...
„ (Woodhouse Moor)	E. Filliter, Esq., C.E.	8	0 9	305	26·40	183
„ (Weetwood Hall)	H. C. Marshall, Esq.	5	0 7	400	29·85	193
„ („ Reservoir)	E. Filliter, Esq., C.E.	8	0 9	325	29·04	198
„ (Allerton Hill)	T. Fenwick, Esq., C.E.	5	0 7	418	27·53	171
„ (Eccup)	E. Filliter, Esq., C.E.	8	0 9	340	30·12	194
Keighley (Braithwaite)	Mr. W. Shackleton	5	6 6	770	48·96	187
Otley	T. E. Thorns Esq.	8	0 7	206	32·13	157
Harewood (Arthington)	E. Filliter, Esq., C.E.	8	0 9	140	31·65	175
Ilkley (Rumbold House)	Dr. Scott	5	0 1	500	47·43	167
„ (Myddleton)	„ „	5	0 1	500	51·47	180
† York (Bootham)	F. Thorp, Esq.	5	0 6	50	27·92	196
† „ (Coney Street)	Mr. Sigsworth	5	8 0	40	25·30	...
„ (Cherry Hill)	H. Richardson, Esq.	5	1 4	60 ?	25·73	...
Thornton-in-Craven	T. Wilson, Esq.	5	5 4	456	45 63	217
Whiteholme [Clitheroe]	Mrs. Birchall	5	1 3	475	57·32	...
Skipton (Woodlands)	J. Heelis, Esq.	5	0 8	430	41·87	191
„ (Rockville)	Rev. H. M. Stallybrass	5	4 0	470	40·20	180

DIVISION IX.—YORKSHIRE—(*continued*).

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which ·01 or more fell.
		Diameter.	Height Above Ground	Height Above Sea Level	1869	
			ft. in.	feet.	inches	
WEST RIDING—(*con.*)						
†Harrogate	J. Coupland, Esq.	8	0 6	380	29·45	148
Pateley Bridge (Fog Close Ho.)	E. Warburton, Esq.	5	2 4	431	47·40	191
Settle	J. Tatham, Esq.	12	40 0	498	41·54	...
Arncliffe	Rev. W. Boyd	8	2 9	750	65·01	189
Ingleborough	J. Farrer, Esq.	...	...	...	45·46	...
Ripon (Littlethorpe)	Mrs. Swire	5	1 0	70	27·24	156
„ (The Knoll)	Rev. F. W. Stow	5	0 6	112	30·15	152
Wharfedale (Oughtershaw School)	C. H. L. Woodd, Esq.	5	1 4	1200	76·07	...
„ („ Hall)	„ „	8	3 0	1175	83·91	114
Sedbergh (Thorne)	Miss Elam	5	1 1	400?	61·48	211
EAST RIDING.						
Patrington	W. B. Pugh, Esq.	5	4 8	22	27·85	203
†Hull (Manor House Street)	W. Lawton, Esq	5	0 10	14	26·07	182
† „ (Beverley Rd., York Parade)	J. Smith, Esq.	8	3 10	11	28·29	189
„ (Baker Street)	A. O. Atkinson, Esq.	5	1 0	10	27·17	...
„ (People's Park)	Mr. E. Peak	5	0 6	0	28·18	192
„ (Cottingham)	J. H. Hill, Esq.	8	1 3	25	27·25	189
†Holme-on-Spalding-Moor	G. Dunn, Esq.	5	6 4	33	24·73	182
Beverley	T. Dyson, Esq.	12	8 0	46	25·50	166
Thorganby (Thicket Priory)	Miss M. C. D. Jefferson	6	1 4	26	21·92	98
Beverley (Middleton)	Rev. H. D. Blanchard.	8	1 6	150	28·30	152
Pocklington (Warter)	J. Coxon, Esq.	5	1 10	...	29·79	195
Little Driffield	W. Lakin, Esq.	8	1 3	35	28·06	...
Ganton Hall [Scarborough]	Mr. Boult	5	1 0	150?	30·66	167
NORTH RIDING.						
Flaxton Grange	H. Richardson, Esq.	5	0 9	130?	25·01	...
†Malton	H. Hurtley, Esq.	10	1 0	75	28·69	...
BA*Filey Reservoir	Mr. D. Philliskirk	5	9 0	183	21·92	...
Thirsk	A. O. Atkinson, Esq.	5	2 6	114	25·42	...
Beadlam Grange	J. H. Phillips, Esq.	5	0 6	192	29 21	...
Scarborough	Dr. Cornelius Fox	5	1 0	102	29·73	172
Hawes (Vicarage)	N. H. Matthews, Esq.	5	1 3	783	68·91	193
Bedale (Leyburn)	G. W. Wray, Esq.	7	2 3	650	38·40	...
BA*Northallerton	Dr. Hodgson	5	1 3	...	25·23	...
Catterick (Tunstall)	H. C. Marshall, Esq.	5	1 0	350	29·25	...
Richmond (Aske)	Mr. J. Miller	12	2 8	550	31·85	...
BA*Whitby	M. Simpson, Esq.	5	2 0	184	23·83	...
„ (Ruswarp)	A. O. Atkinson, Esq.	5	1 6	7	27·20	...
BA*Port Mulgrave	A. S. Palmer, Esq.	5	4 4	350	22·87	100
Greta Bridge Thorpe Grange)	T. Dodgson, Esq.	5	1 6	...	30·98	...
Middlesborough (Marton Hall)	H. W Bolckow, Esq. MP	...	1 3	120	24·15	...
„	W. Fallows, Esq.	8	1 0	21	21·07	131

DIVISION X.—NORTHERN COUNTIES.

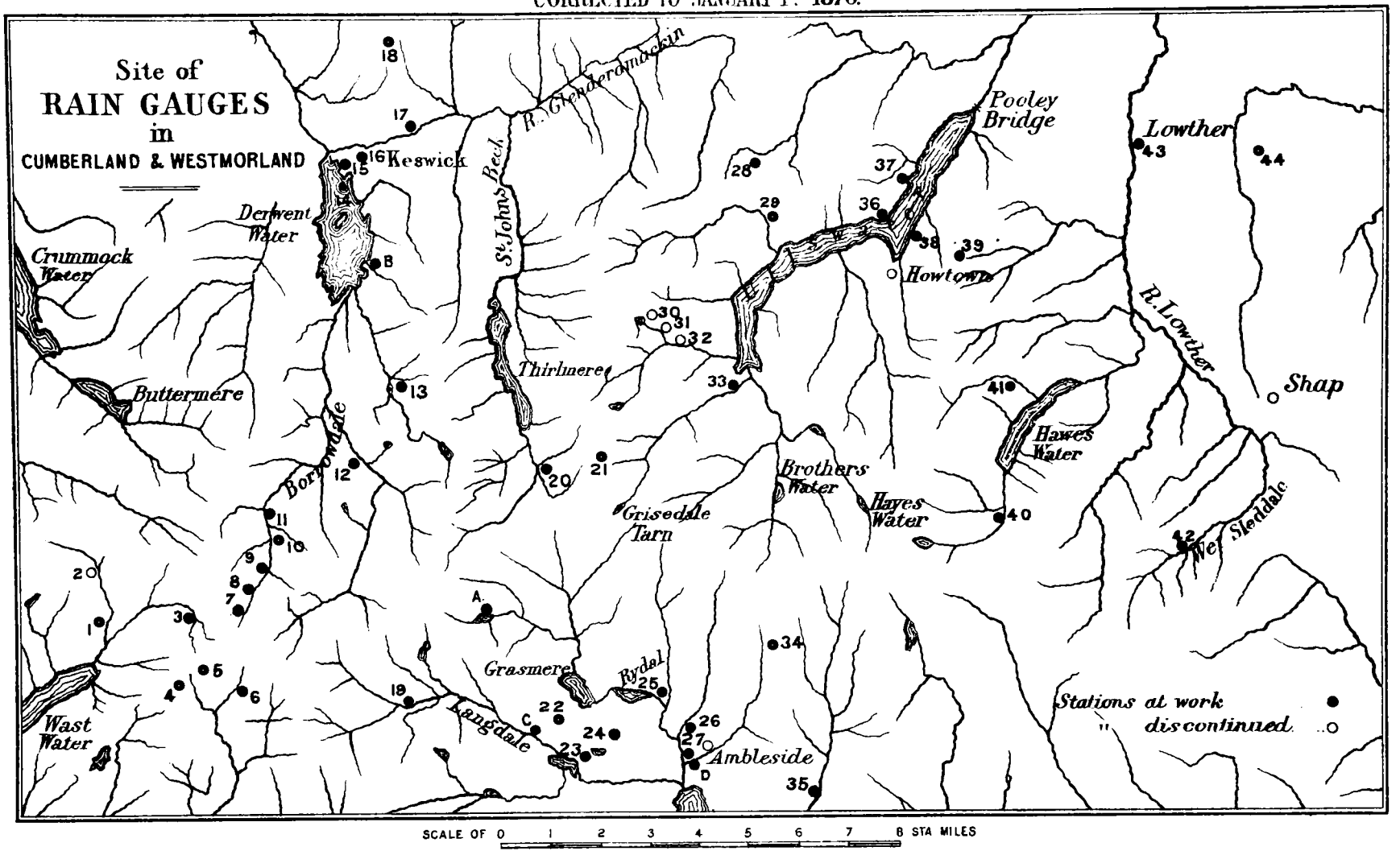
STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground.	Height Above Sea Level	Depth of Rain. 1869	Days on which .01 or more fell
			ft. in.	feet.	inches.	
DURHAM.						
*Darlington (Dinsdale)	Rev. J. W. Smith	5	2 0	50	26·32	157
Eaglescliffe [Yarm]	Rev. J. Hull	5	1 0	80	23·74	205
Darlington (Southend)	Mr. J. Richardson	5	4 0	140	24·03	125
„ (Brinkburn)	Rev. R. F. Wheeler	8	1 0	50	25·75	102
„ (Gainford)	A. Atkinson, Esq.	...	7 0	258	26·75	...
Sedgefield	Dr. Smith	5	0 10	360	28·88	194
„ „ *second gauge*	„ „	5	0 10	360	27·14	...
Wolsingham (St. John's)	C. J. Backhouse, Esq.	5	1 1	928	30·87	167
„	A. Mitchell, Esq.	5	1 0	463	36·70	...
Stanhope Castle	Mr. T. Surtees	8	3 0	670	44·16	...
Durham Observatory	J. J. Plummer, Esq.	12	4 6	335	29·56	164
„ (S. Cuthbert's Col. Ushaw)	Rev. Dr. Gillow	5	0 10	600	26·82	163
Seaham (Hall)	R. Draper, Esq.	5	1 0	80	24·22	132
„ (Vicarage)	Rev. A. Bethune	5	0 4	80	25·46	109
Sunderland (West Hendon)	T. W. Backhouse, Esq.	5	1 0	132	24·25	...
† „ (The Hall)	Rev. G. Iliff	10	1 5	85	25·36	...
Bishopwearmouth	Dr. Ogden	8	30 0	130	17·85	...
„ (Esplanade)	Dr. Pyle	...	8 2	128	25·34	...
NORTHUMBERLAND.						
Allenheads	M. Varty, Esq.	8	0 9	1360	54·44	219
Shotley Hall	Mr. J. Coulson	5	0 3	312	26·22	148
Haydon Bridge (Whitfield)	Rev. J. M. Mason	5	1 0	806	45·84	174
Bywell	Mr. J. Dawson	8	0 6	87	24·97	214
Wylam Hall	G. C. Atkinson, Esq.	10	0 4	96	25·15	157
„ (Horsley)	Rev. R. F. Wheeler	5	0 6	...	22 68	150
Newcastle and Gateshead W. W. Hallington	„ „ „	...	0 6	469	28·54	...
„ (Fawcett)	„ „ „	...	0 6	563	26·95	...
North Tyne (Green Crag)	„ „ „	...	0 6	800	30·59	...
„ „ (Valley)	„ „ „	...	0 6	...	29·20	...
Gunnerton Burn (Camphill)	„ „ „	...	0 6	676	29·90	...
Swinburn (Woodford)	„ „ „	..	0 6	500	29·36	...
Newcastle (Philos. Soc.)	W. Lyall, Esq.	8	1 5	105	30·01	160
„ (Town Moor)	Rev. R. F. Wheeler	5	0 6	201	24·78	155
North Shields (Wallsend)	J. W. Dees, Esq.	10	0 6	100	24·35	...
† „ (Rosella Place)	R. Spence, Esq.	8	1 0	124	23·94	166
„ (Low Lights)	J. R. Procter, Esq.	8	3 1	12	22·42	160
„ (Tynemouth)	P. J. Messent, Esq.	5	1 2	62	22·68	174
„ (Clementhorpe)	J. R. Procter, Esq.	5	1 0	150	20·70	163
* „ (Whitley)	Rev. R. F. Wheeler	5	0 9	83	23·03	...
„ (Earsdon)	John Taylor, Esq.	5	2 10	185	21·85	129
Stamfordham	Rev. J. F. Bigge	8	1 0	400	24·93	...
„ (Church Tower)	„ „ „	10	42 0	452	18·36	...
Hexham (Parkend)	M. A. Ridley, Esq.	10	0 4	276	33·43	201
Bellingham (Hesleyside)	W. H. Charlton, Esq.	10	3 7	420	49·52	108
Hartburn (Wallington)	H. Laws, Esq.	5	1 0	398	29·25	193
Bellingham (Otterburn)	Rev. T. Wearing	10	1 0	500	29·88	...
Rothbury (Brenckburn Priory)	C. H. Cadogan, Esq.	5	1 0	200	25·24	80
Deadwater	Mr. Scott	3	1 6	2000	50·30	...

DIVISION X.—NORTHERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground. ft.	in.	Height Above Sea Level feet.	Depth of Rain. 1869 inches.	Days on which ·01 or more fell.
NORTHUMBERLAND—(*con.*)							
Rothbury (Cragside)	Rev. R. F. Wheeler	8	1	0	400	26·94	...
Rochester (Byrness)	„ „ „	10	2	0	700	34·35	...
Alnwick (Glanton Pyke)	F. W. Collingwood, Esq	8	4	4	534	25·14	...
Howick	Earl Grey, K.G.	8	0	10	120	22·66	130
Lilburn Tower	E. J. Collingwood, Esq	10	6	0	290	23·97	...
Belford (Middleton Hall)	J. T. Leather, Esq. C.E.	10	2	0	240	23·21	..
Bamburgh (North Sunderland)	Rev. F. R. Simpson	8	1	2	60	20·09	173
*Wooler (Milfield)	G. A. Grey, Esq.	5	0	4	200	23·34	...
CUMBERLAND.							
Bootle (Whitbeck)	Rev. T. Ormandy	2	1	0	...	46·52	146
„ (Rectory)	Rev. A. Wilkin	12	1	5	87	42·05	179
Whitehaven (Braystones)	J. D. Watson, Esq	10	3	8	36	40·77	...
Scawfell Pike .....*monthly* (4)	I. Fletcher, Esq., M.P.	4	0	6	3200	59·06	...
Esk Hause ..... „ (6)	„ „ „	4	0	6	2550	89·75	...
Great End ..... „ (5)	„ „ „	4	0	6	2982	63·99	...
†Wastdale Head ..... „ (1)	„ „ „	4	0	6	247	101·00	...
Brant Rigg..... „ (3)	„ „ „	4	0	6	695	87·32	...
Sprinkling Tarn..... „ (7)	„ „ „	4	0	6	1985	126·95	...
Stye Head Tarn..... „ (8)	„ „ „	4	0	6	1472	133·70	...
The Stye..... „ (10)	„ „ „	4	0	6	1077	198·19	...
Taylor's Gill ..... „ (9)	„ „ „	4	0	6	1077	179·07	...
†Seathwaite ..... „ (11)	„ „ „	4	0	6	422	133·03	...
† „ ..... „ (11)	Mrs. Dixon	8	1	0	422	140·00	...
† „ .....*daily* (11)	I. Fletcher, Esq., M.P.	5	1	0	422	150·11	...
Stonethwaite .....*monthly*(12)	„ „ „	4	0	6	330	114·72	...
St. Bees	W. C. Hughes, Esq.	8	1	6	100	37·18	...
Cleator (The Flosh)	T. Ainsworth, Esq.	5	2	0	112	50·87	186
†Wythburn Parsonage „ (20)	Rev. Basil Lawson	8	1	0	574	103·50	...
†Helvellyn (Birkside) „ (21)	G. J. Symons, Esq.	8	1	0	1800	98·25	...
†Watendlath .....(13)	„ „ „	8	1	0	867	91·00	...
Keswick (Barrow House).....(B)	S. Z. Langton, Esq	8	0	6	240	83·43	213
Whitehaven (Millgrove) *monthly*	H. A. Fletcher, Esq.	8	1	6	210?	43·63	...
Loweswater (Waterend)	R. Jackson, Esq.	5	0	8	240?	55·44	193
†Gowbarrow Fell .....(29)	G. J. Symons, Esq.	8	1	0	1100	64·80	...
† „ (Watermillock) ...(37)	Mr. W. Rumney	10	3	6	720	63·60	143
†Matterdale Common .....(28)	G. J. Symons, Esq.	8	1	0	1400	87·95	...
†Keswick (Crow Park) .....(15)	H. C. Marshall, Esq.	10	4	0	295	55·40	...
„ „ „ „)	„ „ „	7	1	9	280	64·62	...
† „ (Derwent Island) ...(14)	„ „ „	5	1	0	280	59·65	219
† „ (Post Office) .....(16)	Mr. Crosthwaite	8	6	4	270	72·00	179
ℬ* „ „ ...(16)	„ „	5	1	0	270	70·39	179
† „ (Greta Bank) .....(17)	J. J. Spedding, Esq.	5	1	0	400	62·82	195
†Skiddaw .....(18)	G. J. Symons, Esq.	8	1	0	1677	54·50	...
Mosser (Beech Hill)	John Alderson, Esq.	5	2	3	550	53·91	...
†Bassenthwaite (Mirehouse)	Mrs. Spedding	5	0	7	310	55·61	182

NOTE.—The numbers in parentheses on this and two following pages refer to the accompanying Map.

CORRECTED TO JANUARY 1ST 1870.



DIVISION X.—NORTHERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground. ft.	Height Above Sea Level in.	feet.	Depth of Rain. 1869 inches.	Days on which '01 or more fell.
CUMBERLAND—(*con.*)							
Cockermouth (Whinfell Hall) ...	W. Robinson, Esq. ...	5	2	0	266	58·81	218
Workington (Stainburn)	C. Litt, Esq.	8	0	6	99	40·09	206
„ (Park End)	W. Thompson, Esq....	5	1	2	124	41·41	209
Cockermouth	Dr. Dodgson	8	0	6	158	46·31	183
„ (on a post)	„ „ „	8	6	6	164	44·48	183
„ (on Church Tower)...	„ „ „	8	100	0	258	22·86	...
„ (Tarnbank)	I. Fletcher, Esq., M.P.	8	0	6	225	47 71	188
„ „	„ „	10	5	0	230	47·07	188
„ „	„ „	12	40	0	272	33·98	188
„ (Higham)	Rev. T. A. Hoskins ...	8	0	6	478	47·08	187
„ (Bridekirk)	Rev. J. Carter	8	0	6	350	37·98	...
Penrith.....	T. Lester, Esq.	5	0	9	...	29·41	141
† „ (Edenhall).....	Mr. T. Bowstead	5	1	0	320?	30·50	...
Aspatria (Brayton Hall)	Mr. R. Elliot.....	8	0	5	220	39·62	...
Alstone (Nenthead)	W. Dalton, Esq	5	1	0	1416	41·58	...
Maryport (Netherhall)	H. P. Senhouse, Esq...	8	0	6	27	36·74	...
Carlisle (Cemetery).....	Mr. J. Cameron, Jun.	8	0	0	114	27·66	...
„ (Scaleby Hall)	R. A. Allison, Esq. ...	5	1	1	100?	35·20	162
WESTMORELAND.							
Burton (Dalton Hall)	E. G. S. Hornby, Esq.	5	0	1	...	50·16	...
Kirkby Lonsdale (Casterton).....	S. Morris, Esq.	8	1	0	305	51·21	200
„ „ („) *monthly*	„ „ „	8	1	0	305	51·48	...
„ „ (Biggins House)	Miss Tomlinson.....	12	3	6	400	51·99	...
„ „ (Whelprigg) ...	Mrs. Gibson	5	4	6	475	50·02	...
„ „	Mr. W Harrison	5	1	2	209	51·22	...
„ „ (Vicarage)	Rev. H. Ware	5	1	0	210	51·44	..
„ „ (Rigmaden) ...	E. Wilson, Esq.	6	3	0	350	56·41	...
Crosthwaite (Churchtown)	W. Garnett, Esq.	5	1	3	150	57·23	198
†Kendal (Kent Terrace)	R. J. Nelson, Esq.....	8	4	6	149	55·50	178
„ (Highgate).....	E. Hayton, Esq.	8	5	0	180	56·08	192
„ (Underfell)	J. J. Wilson, Esq.....	8	4	6	300	52·87	192
Stavely (Middle Fairbank)	T. K. Atkinson, Esq...	10	3	0	...	72·09	195
Windermere (Matson's Grounds)	G. Healey, Esq.....	12	0	8	405	66·53	159
„ (High House)	E. Hayton, Esq.....	8	4	0	636	62·04	...
„ (The Wood).....	G. B. Crewdson, Esq..	8	3	2	310	76·06	204
† „ (The Howe) ...(35)	Admiral Wilson	8	1	2	470	82·07	176
Ambleside (The Nurseries) ...(D)	Mr. J. Grier	5	1	2	140	81·20	193
Loughrigg Fell ... .(24)	E. B. W. Balme, Esq.	8	1	0	1050	74·00	...
Langdale (Brigg Howes) ... (C)	Mr. E. Tucker	5	0	9	250	115·11	217
†Grasmere (High Close) .....(22)	E. B. W. Balme, Esq.	8	0	9	553	90·78	221
Langdale .....(19)	„ „ „	8	1	0	380	118·50	...
*Kirkby Stephen	T. Mason, Esq.	5	1	1	574	39·32	177
Rydal.....(25)	F. M. T. Jones, Esq...	5	1	6	175	90·83	...
†Kirkstone Pass.....(31)	G. J. Symons, Esq. ...	5	1	0	1500	97·29	...
†Grasmere (Easedale Tarn) ...(A)	„ „ „	8	1	0	1175	107·00	...
†Haweswater(Mardale Green)(40)	„ „ „	8	1	0	800	101·75	...
Shap (Crosby Ravensworth) (E)	Rev. G. F. Weston ...	8	0	5	600	55·53	179
†Haweswater(Measandbecks) (41)	G. J. Symons, Esq. ...	8	1	0	1200	62·00	...

DIVISION X.—NORTHERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground	Height Above Sea Level	Depth of Rain. 1869	Days on which '01 or more fell.
			ft. in.	feet.	inches	
WESTMORELAND—(*con.*)						
†Patterdale Hall ..... (33)	Mr. Sinclair	7	2 0	490	90·16	...
Appleby	Dr. Armstrong	8	1 0	442	37·49	178
†Ullswater (Swarth Fell).....(39)	G. J. Symons, Esq. . .	8	1 0	1000	53·00	...
„ (Sharrow Bay) *monthly*(38)	A. Parkin, Esq.....	8	1 6	500	40·47	...
„ „ .....*daily*	„ „	5	0 7	500	59·29	...
†Great Strickland [Penrith] (44)	H. Plumer, Esq.....	5	1 6	650	44·67	182
†Brougham Hall [Penrith].....	Mr. G. Campbell	5	1 0	470	39·21	163

DIVISION XI.—MONMOUTH, WALES, AND THE ISLANDS.

MONMOUTH.							
*Newport(Llanfrechfa Grange)	F. J. Mitchell, Esq. ...	5	1	0	360	46·49	148
* „ (Cwmbrân Parsonage)...	Rev. J. Rees Jenkins..	5	1	0	330	50·05	159
Chepstow (Tutshill)	J. G. Wood, Esq.	8	3	6	200	41·44	149
„ (The Mount)	H. Clay, Jun., Esq. ...	5	1	6	200?	42·51	145
Tintern Abbey.....	Mr. W. Bowen	5	1	0	16	45·90	166
Tredegar (Ebbw Vale)	P. James, Esq.	5	1	0	918	62·47	192
„ (Sirhowy)	R. Jordan, Esq.....	5	0	9	1055	64·29	191
Monmouth (Dingestow).....	S. R. Bosanquet, Esq.	5	1	0	400	37·52	...
Abergavenny	Dr. McCullough	5	1	3	220	38·51	175
GLAMORGAN.							
*Cowbridge (The Ham)	G. W. Nicholl, Esq ...	8	1	3	50	31·20	145
Cardiff (Town Hall)	T. Waring, Esq.....	5	1	1	20	40·85	173
„ (Spring Bank)	H. Bowen, Esq.....	10	5	0	35	36·07	...
„ (Ely)	T. G. South, Esq. C.E.	5	3	0	45	40·39	162
„ (Tredegarville)	W. Adams, Esq.	5	1	0	40?	38·13	179
„ (Pentyrch)	F. G. Evans, Esq.....	5	1	1	100	51·62	198
„ (Lisvane)	T. G. South, Esq. C.E.	5	2	0	142	38·19	161
Swansea (Harbour Office).....	J. W James, Esq.....	12	14	9	40	34·19	173
„ (Lliw Reser., Felindre)..	E. Cousins, Esq.	8	3	0	420	52·12	154
Aberdare (Dare Villa)	Evan Jones, Esq.	5	1	6	450	57·44	128
„ (Mardy).....	W. T. Lewis, Esq.....	5	1	1	431	70·35	185
MerthyrTydfil(Thomas Town)...	T. J. Dyke, Esq.....	5	2	0	550	60·57	163
Ystalyfera	Dr. D. Thomas	8	4	4	220	63·44	152
CARMARTHEN.							
Llanelly (West End Terrace) ...	D. M. Llewellyn, Esq.	5	0	10	20	45·38	197
„	E. Bagot, Esq., C.E....	5	3	0	20	42·28	198
Llanstephan (The Cottage)	W. Ainslie, Esq.....	5	0	5	35	38·85	211
BA*Carmarthen—(PlasCwrtHyr)	W. E. Gwynn, Esq....	5	3	6	300?	56·17	180
„ (Gaol)	G. Stephens, Esq.....	8	0	6	72	48·86	210
„ (Joint Co. Asylum)..	Dr. Hearder	8	0	6	185	50·24	193
Llandeilo-Fawr (Taliaris Park)..	Herbert Peel, Esq. ...	5	0	6	600?	54·68	...
Narberth (Tegfynydd)	H. S. Morgan, Esq. ...	5	1	0	158	50·84	141
PEMBROKE.							
Tenby	Dr. Dyster.....	8	5	0	60	?28·17	189
*Haverfordwest (High Street).....	E. P. Phillips, Esq. ...	5	1	0	95	54·69	155

DIVISION XI.—MONMOUTH, WALES, AND THE ISLANDS—(*continued*).

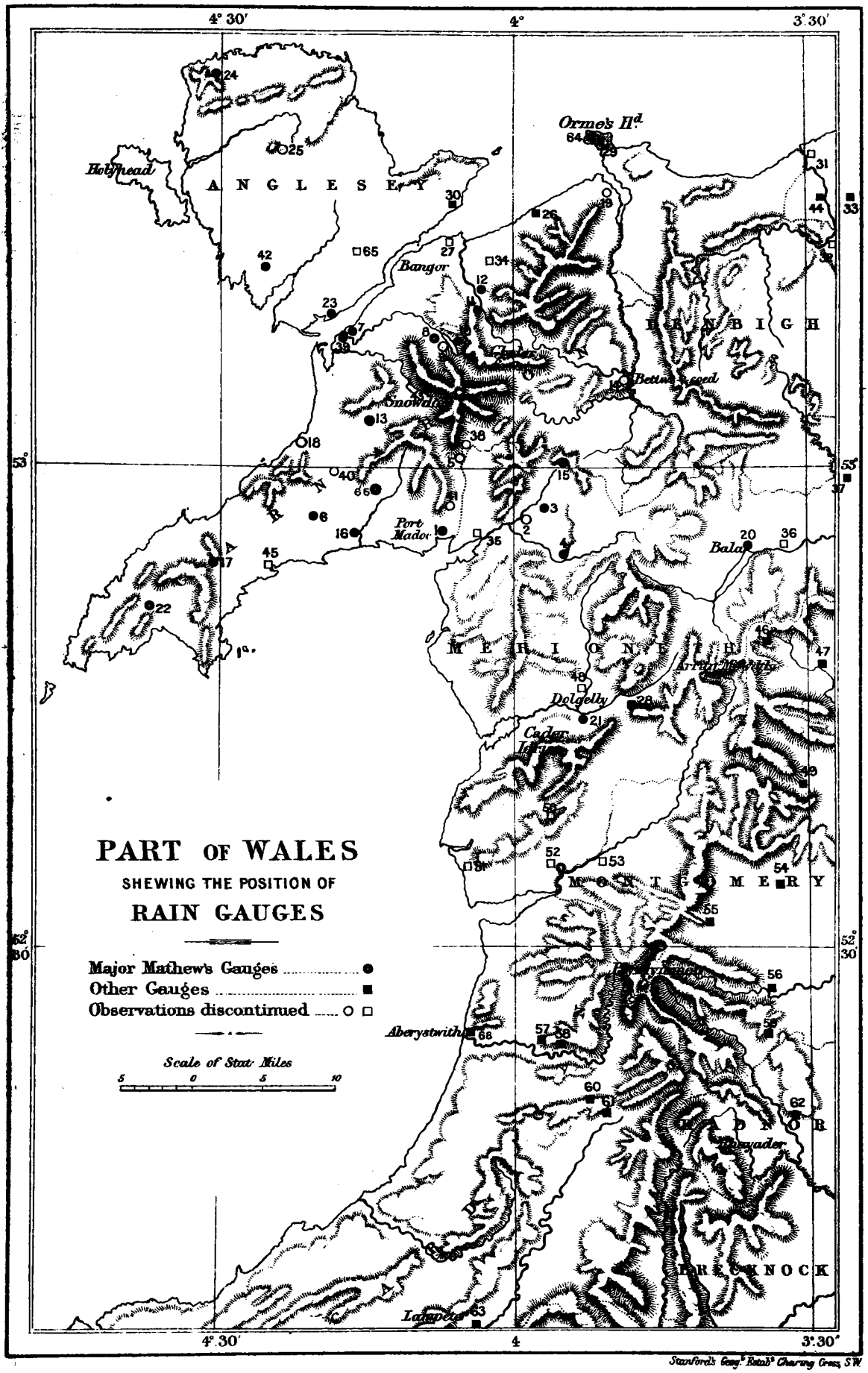
STATIONS.	AUTHORITIES.	Rain Gauge. Diameter	Height Above Ground. ft.	in.	Height Above Sea Level	Depth of Rain. 1869	Days on which ·01 or more fell.
					feet.	inches.	
CARDIGAN.							
Kilgerran (Castle Malgwyn).....	Rev. D. Evans	5	1	2	80	44·11	...
Lampeter ..... (63)	Rev. J. Matthews	8	5	0	420	47·23	186
Aberystwith (Goginan) .....(58)		...	4	0	290	47·09	...
„ (Capel Bangor) (57)	T. Paul, Esq.	5	1	0	42	43·06	192
BRECKNOCK.							
Crickhowell (Glanusk Park).....	Mr. Ireland	8	0	6	300	48·70	...
Brecknock	J. Kirk, Esq...	5	2	0	437	50·67	149
Hay (Pen-y-maes)	Captain Brown	5	1	1	317	35·47	169
RADNOR.							
*Presteign	Captain Hannam	5	1	0	550	35·63	188
Rhayader (Cefnfaes) ..... (62)	Mrs. Jones	5	2	0	880	45·98	177
MONTGOMERY.							
Llanidloes (Broomcliff) .....(56)	T. F. Roberts, Esq. ...	5	6	4	610	51·85	158
Machynlleth (Plas)	Mr. Johnstone	5	1	0	...	70·57	173
FLINT.							
Mold (Bryn Alyn)	Rev. R. B. Cooke	5	1	4	480	36·04	...
†Hawarden [Chester]	Dr. Moffat	8	0	7	270	32·91	...
Holywell (Maes y dre)	J. Williams, Esq.	10	5	0	400	30·38	...
St. Asaph (Brynbella).....(33)	P. P. Pennant, Esq. ...	5	1	0	280	32·03	...
„ (Llanerch)	Whitehall Dod, Esq....	5	1	1	120?	31·32	181
DENBIGH.							
Chirk (Brynkinalt)	Mr. Hall.....	8	1	2	...	31·53	...
Wrexham (Wynnstay)	F. G. Tippinge, Esq...	...	...		486	36·76	...
„ (Llwyn Onn)	„ „ „ ...	5	1	0	213	31·22	179
„ (Plas Power).....	„ „ „ ...	...	...		472	37·00	...
„ (Grove Lodge)	C. Napier, Esq.	5	1	1	272	28·74	...
„ (Brymbo)	C. E. Darby, Esq.....	6	6	3	620?	34·08	...
„ (Gwersyllt Hill)	W. Lassell, Jun., Esq..	8	2	0	400?	41·47	156
Rosset (Trevalyn Hall)	Capt. Griffith.....	5	1	0	60?	27·99	187
†Llandudno (Warwick House) (29)	Dr. Nicol.....	8	0	6	99	34·23	173
„ (Great Orme's Head)(64)	„ „	12	6	0	175	27·96	...
MERIONETH.							
*Dolgelly.....(21)	Major Mathew	5	1	0	43	69·91	121
*„ (Brithdin) .....(28)	J. Hill, Esq.	5	2	0	500	77·24	...
*Festiniog (Blaenyddol) .....(3)	Major Mathew	5	1	0	600	85·51	203
*Rhiw brifdir.....(15)	„ „	5	10	0	1100	107·55	219
Corwen (Rhug) .....(37)	J. Wagstaff, Esq.	8	3	0	400?	35·68	...
CARNARVON.							
Aberdaron (Sarn).....(22)	Mr. W. Jones.....	12	5	0	340	51·70	204
*Pwllheli (Bodfaen) .....(17)	Major Mathew	5	4	9	80	48·60	210
*Llanystumdwy (Talarvor) ...(16)	„ „	5	3	0	50	48·11	161
*Llangybi (Cefn) .....(6)	„ „	5	1	1	200	55·24	206
*Port Madoc.....(1)	„ „	5	3	0	10	57·47	205
*Llanberis (Dinorwic Quarry)(10)	„ „	5	1	10	850	59·38	224
* „ (Glyn Padarn) .....(8)	„ „	5	1	0	377	73·66	206
Carnarvon (Cocksidia).....(39)	„ „	5	1	1	120	45·46	208

NOTE.—The numbers in parentheses on this and the following page refer to the accompanying Map

DIVISION XI.—MONMOUTH, WALES, AND THE ISLANDS—(*continued*)

STATIONS.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which '01 or more fell.
		Diameter.	Height Above Ground	Height Above Sea Level	1869	
			ft. in.	feet.	inches.	
CARNARVON—(*con.*)						
* Carnarvon (Plas Brereton) ...(7)	T. Turner, Esq.	5	1 0	25	43·55	193
Bethesda (Brynderwen) .....(12)	Major Mathew	5	1 0	550	67·78	216
† Llanfairfechan .....(26)	R. Luck, Esq.....	5	0 8	150	38·50	155
ANGLESEA						
Menaifron .....(23)	Rev. W. W. Williams	5	4 9	17	42·51	213
Bidorgan (Llangadwaladr)...(42)	Major Mathew	5	3 6	50	42·26	218
Beaumaris (Henllys) .....(30)	Miss Hampton	...	1 6	150	46·02	...
Llanfairynghornwy .....(24)	Major Mathew	5	5 0	120	41·23	198
ISLE OF MAN.						
Douglas Head.....	Bd. of Northern Lights	...	0 6	...	31·65	...
„ (Derby Square)	P. Killey, Esq.	5	1 1	90?	42·77	210
Point of Ayre	Bd. of Northern Lights	...	3 4	27?	27·65	...
ISLES OF SCILLY.						
† Tresco Abbey (upper gauge) ...	Augustus Smith, Esq..	11	2 8	50	28·05	169
† „ „ (lower „) ...	„ „ „	11	3 0	40	30·05	168
GUERNSEY.						
Guernsey	Dr. Hoskins, F.R.S. ...	12	12 0	204	32·99	162
„ (Grange Road).....	Dr. Mansell	5	1 0	174	35·98	179
JERSEY.						
Millbrook	P. Langlois, Esq.	5	1 0	50	30·54	174
ALDERNEY.						
Alderney	J. May, Esq., C.E.....	12	10 0	48	31·59	161
SARK.						
Sark Parsonage	Rev.T.LV.Cachemaille	5	1 0	340	28·58	171

Corrected to January 1st 1870.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4°
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Holyhead
ANGLESEY
Ormes Hd.
Bangor
Snowdon
Bettws y coed
Port Madoc
Bala
MERIONETH
Dolgelly
Cader Idris
MONTGOMERY
Aberystwith
Machynlleth
Llanidloes
Newtown
Llanfyllin
Welshpool
Oswestry
Llangollen
Wrexham
Mold
Holywell
Denbigh
Ruthin
Corwen
Llandrillo
Llangynog
Llanfyllin
Llanrwst
Conway
Carnarvon
Pwllheli
Barmouth
Dolgelly
Machynlleth
Aberystwith
Cardigan
Newcastle Emlyn
Llandyssil
Newtown
Llanidloes
Rhayader
BRECKNOCK
Llandovery
Llangadock
Llandilo
Carmarthen
Llanelly
Swansea
Neath
Aberavon
Cowbridge
Cardiff
Newport
Pontypool
Abergavenny
Crickhowell
Brecon
Hay
Builth
Llandrindod
Presteigne
Knighton
Montgomery
Welshpool
Llanfyllin
Llangynog
Llandrillo
Corwen
Ruthin
Denbigh
Holywell
Mold
Wrexham
Oswestry
Llangollen
Llanfyllin
Llanrwst
Conway
Carnarvon
Pwllheli
Barmouth
Dolgelly
Machynlleth
Aberystwith
Cardigan
Newcastle Emlyn
Llandyssil
Newtown
Llanidloes
Rhayader
Builth
Llandrindod
Presteigne
Knighton
Hay
Brecon
Crickhowell
Abergavenny
Pontypool
Newport
Cardiff
Cowbridge
Aberavon
Neath
Swansea
Llanelly
Carmarthen
Llandilo
Llangadock
Llandovery
Brecknock
Monmouth
Chepstow
Usk
Caerleon
Tredegar

SCOTLAND.

DIVISION XII.—SOUTHERN COUNTIES.

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Rain Gauge. Height Above Ground.	Rain Gauge. Height Above Sea Level	Depth of Rain. 1869	Days on which ·01 or more fell.
			ft. in.	feet.	inches.	
WIGTOWN.						
Mull of Galloway	Bd. of Northern Lights	...	...	...	24·29	...
BA*Wigton (N. Balfern)	T. MacLelland, Esq....	5	0 11	75	40·36	190
Stranraer (South Cairn)	Mr. J. Kennedy	3	0 4	209	60·20	174
Corsewall	Bd. of Northern Lights	...	3 4	22 ?	34·54	...
KIRKCUDBRIGHT.						
Little Ross	Bd. of Northern Lights	...	3 3	130 ?	24·92	...
BA*Dalbeattie	J. Grieve, Esq.	5	0 8	25 ?	46·89	167
Castle Douglas (Slogarie)	Miss Bruce	4	0 6	800	55·95	...
„ „ „	„ „ „	8	6 0	300	53·79	...
Cargen [Dumfries]	P. Dudgeon, Esq.	3	0 4	80	50·40	128
New Galloway	R. McKay, Esq.	8	20 0	200	48·26	197
BA* „ (Waterside)	A. Buchan, Esq	5	1 5	215	59·00	...
„ (Glenlee)	Mr. W. Melville	3	1 6	217	53·40	...
BA*Carsphairn	J. Hannah, Esq.	5	3 10	574	58·01	176
DUMFRIES.						
Annan (Warmanbie)	A. Buchan, Esq	8	3 0	100	39·09	...
Dumfries (Crichton Asylum)	Dr. Gilchrist	8	0 6	159	38·42	177
„ (March Hill Cott.)	Mr. T. Hogg	5	0 5	70	33·00	...
Dunscore (Allanton)	„ „	...	...	...	44·40	...
Thornhill (Wallace Hall)	C. T. Ramage, Esq.	3	0 10	207	37·60	...
Drumlanrig Castle	A. Buchan, Esq.	...	...	191	43·50	...
Kirkpatrick Juxta (Broomlands)	Mr. Burgess	3	0 2	346	61·98	163
Wanlockhead	Mr. G. Dawson	3	0 4	1330	62·47	182
Langholm	J. Little, Esq.	3	2 0	270	61·80	...
Eskdale. Westerkirk School	„ „ „	4	0 6	400	58·50	...
Eskdale. Ewes School	„ „ „	3	0 6	407	55·25	...
Eskdale. Carlesgill	„ „ „	10	2 0	370	59·05	
Eskdale. Eskdalemuir School	„ „ „	3	0 6	612	62·60	...
Eskdale Pen Top	„ „ „	4	1 0	2268	57·30	...
Whiteholme	Captain Thornton	5	1 0	1350	69·74	...
ROXBURGH.						
Liddlesdale (Whithaugh)	J. Little, Esq.	...	1 0	400	52·60	...
New Castleton (Kirndean)	Miss Elliot	3	0 6	400	49·70	...
„ „ (The Flatt)	J. Elliot, Esq.	3	0 6	350	51·60	...
Hawick (Borthwickbrae)	A. E. Lockhart, Esq...	8	0 2	800	44·10	...
„ (Langraw)	Mr. W. Oliver	5	0 6	570	35 46	...
„ (Goldielands)	Dr. Elliot	...	0 8	505	34·95	...

DIVISION XII.—SOUTHERN COUNTIES—(*continued.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Rain Gauge. Height Above Ground.	Rain Gauge. Height Above Sea Level	Depth of Rain. 1869	Days on which ·01 or more fell.
			ft. in.	feet.	inches.	
ROXBURGH—*(con.)*						
Hawick (Lynnwood)	Dr. Elliot	...	0 6?	387	29·80	...
* „ (Silverbut Hall)	Mr. D. Elder	5	4 0	512	28·30	175
„ (Kirkton)	Mr. J. Welsh	...	0 6?	...	29·60	...
„ (Wolfelee)	Dr. Elliot	...	...	...	40·57	...
„ (Slitrig Crescent)	A. R. Turnbull, Esq.	5	0 6	403	33·66	...
*Jedburgh (Sunnyside)	G. Hilson, Jun., Esq.	5	10 0	360	21·51	...
Galashiels (Wooplaw)	J. Murray, Esq.	5	0 9	881	27·63	188
Kelso (Springwood Park)	Sir G. Douglas, Bt	10	1 0	130	22·23	147

DIVISION XIII.—SOUTH-EASTERN COUNTIES.

SELKIRK.						
Bowhill	Mr. Mathison	6	11 0	537	?28·00	...
PEEBLES.						
Cairnmuir	A. Buchan, Esq.	12	0 3	1150	33·58	...
Penicuick (N. Esk Reservoir)	Mr. J. Garnock	11	0 6	1150	31·50	124
BERWICK.						
Swinton (Milne Graden)	A. Buchan, Esq.	...	...	103	22·60	...
„ Manse	Rev. R. Home	6	0 9	200	24·53	143
Marchmont	Mr. P. Loney	5	1 0	500	31·12	195
Lauder (Thirlestane Castle)	Mr. J. Whitton	3	0 3	558	?24·25	127
Dunse (Mungo's Walls)	Mr. J. Thomson	3	0 6	267	25·18	151
St. Abb's Head	Bd. of Northern Lights	...	0 4	211 ?	16·28	...
HADDINGTON.						
Yester	A. Buchan, Esq.	12	1 0	425	20·77	...
Prestonkirk (Smeaton)	Mr. J. Black	8	8 0	100	?18·38	141
Haddington (Millfield)	Mr. T. Dods	6	4 0	140	19·40	...
Dunbar (Thurston)	A. Buchan, Esq.	...	...	327	21·70	...
East Linton	Mr. J. Storie	3	0 3	90	15·77	...
Drem (Fenton Barns)	G. Hope, Esq.	3	1 0	103	20·60	...
EDINBURGH.						
Cobbinshaw Reservoir	J. Carswell, Esq.	6	0 7	863	35·80	143
Harlaw	A. Ramsay, Esq., C.E.	...	..	...	31·30	...
Glencorse	„ „ „	...	0 6	787	32·40	137
Kirknewton Manse	W. Smiths, Esq.	...	0 10	530	26·35	...
Clubbiedean	A. Ramsay, Esq., C.E.	...	...	...	31·00	...
Swanston	„ „ „	...	0 6	555	28·27	...
Colinton (Fernielaw)	J. Leslie, Esq., C.E.	11	0 6	500	27·60	...
Dalkeith	A. Buchan, Esq.	...	...	190	18·49	...
Inveresk	Mr. McAuslane	9	2 0	60	19·68	118
Edinburgh (Charlotte Square)	J. Leslie, Esq., C.E.	11	0 6	230	22·23	...
„ (March Hall)	A. Buchan, Esq.	...	...	270	25·90	...
Costorphine (Meadowfield)	A. Paterson, Esq.	8	9 4	155	19·02	...
Inchkeith	Bd. of Northern Lights	..	...	...	21·50	...

DIVISION XIV.—SOUTH-WESTERN COUNTIES.

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Rain Gauge. Height Above Ground.	Rain Gauge. Height Above Sea Level	Depth of Rain. 1869	Days on which 01 or more fell
			ft. in.	feet.	inches.	
LANARK.						
Douglas (Newmains)	Mr. J. Russell	3	0 4	783	39·05	146
Uddingston (Meadowbank)	J. Anderson, Esq.	5	15 0	125	26·35	...
Lesmahago (Stockbridge)	A. Buchan, Esq.	...	...	..	58·60	...
Lanark (Baronald)	Captain Thornton	5	1 0	505	31·20	217
,, (Sunnyside)	Miss Leishman	5	1 0	384	28·58	183
Hamilton (Murdostoun Castle)	Mr. Armour	10	4 0	550	32·85	172
,, (Auchinraith)	R. Ker, Esq.	10	4 9	150	27·81	...
,, (Bothwell Castle)	Mr. A. Turnbull	10	18 0	146	24·32	160
Cambuslang (Bushy Hill)	Dr. Muirhead	6	0 4	148	31·30	...
Glasgow (Cessnock Park)	R. Hart, Esq.	10	4 4	30	34·08	192
,, (Observatory)	Professor Grant, F.R.S.	5	0 1	180	39·07	224
Baillieston	Mr. P. Jarvie	6	0 3	230	42·10	213
Coatbridge (Woodside House)	J. Baker, Esq.	5	1 2	275	31·43	117
Shotts (Hillend House)	Mr. D. Thompson	10	7 0	620	30·85	188
AYR.						
Girvan (Pinmore)	Captain Hamilton	5	1 0	187	48·94	...
,,	Mr. P. Paterson	5	0 6	15	?46·81	157
New Cumnock (Whitehills)	W. Lennox, Esq.	5	1 0	860	45·83	180
Ayr (Auchendrane House)	E. Cathcart, Esq.	8	2 3	96	42·85	201
,, ,, (in a pit)	,, ,,	5	0 0	94	44·90	199
Kilmarnock (North Craig)	J. M. Gale, Esq., C.E.	12	0 6	330 ?	40·68	...
Largs (Mansfield)	Dr. Campbell	10	0 6	30	46·20	...
Skelmorlie (Morland)	A. Buchan, Esq.	...	...	...	54·70	...
RENFREW.						
Eaglesham (Revoch)	Mr. J. Scott	3	4 0	700	47·75	...
Gorbals's District. Ryat Lynn	‡Glasgow Water Works	8	0 5	310	44·50	...
Gorbals's District. Waulk Glen	,, ,, ,,	12	0 5	280	45·80	...
Gorbals's District. Middleton	,, ,, ,,	12	0 5	550	52·55	...
Gorbals's District. Black Loch	,, ,, ,,	8	0 5	700	47·05	...
Mearns (Newton)	P. R. Murdoch, Esq.	5	0 8	360	45·01	...
,, (Netherplace)	W. Mather, Esq.	4	0 6	350	46·75	...
Paisley (Ferguslie House)	A. Buchan, Esq.	...	...	...	45·22	...
Shaws W. Works (Loch Thom)	J. Wilson, Esq.	6	0 9	650	64·80	...
,, ,, (Compen. Res.)	,, ,, ,,	6	0 9	560	64·30	...
,, ,, (Shiel Hill)	,, ,, ,,	6	0 9	800	63·30	...
,, ,, (Spango Burn)	,, ,, ,,	6	0 9	540	60·00	...
Greenock (Hamilton Street)	Mr. Anderson	6	0 6	50	64·47	215
,, (Gourock)	W. Melvin, Esq.	6	0 6	250	61·20	171

DIVISION XV.—WEST MIDLAND COUNTIES.

DUMBARTON.							
Dumbarton (Cardross)	J. W. Burns, Esq.	3	0	2	96	47 50	139
,, (Balloch Castle)	A. J. D. Brown, Esq.	7	0	4	91	48·30	198
Helensburgh (Larch Villa)	J. Cramb, Esq.	5	0	6	65	49·11	...
Loch Lomond (Ardlui)	A. McDowall, Esq.	3	1	0	50 ?	117·50	...
,, ,, (Firkin)	,, ,,	3	0	6	90 ?	93·50	...
Loch Long (Arddaroch)	J. White, Esq.	5	0	10	80	69·35	173
Arrochar (Upper Inveruglass)	A. McDowall, Esq.	3	2	0	100 ?	117·30	...

‡ Information supplied by J. M Gale, Esq., C.E.

DIVISION XV.—WEST MIDLAND COUNTIES—*(continued.)*

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground.	Height Above Sea Level	Depth of Rain. 1869	Days on which ·01 or more fell.
			ft. in.	feet.	inches.	
STIRLING.						
Strathblane(Mugdock Reservoir)	Glasgow Water Works	8	0 6	320	44·60	...
Falkirk (Kerse)	Earl Zetland, K.T. ...	8	1 0	...	28·80	...
Stirling (Polmaise Gardens).. ...	Mr. Gorrie	6	0 2	12	35·85	...
BUTE.						
Pladda	Bd. of Northern Lights	...	3 3	55 ?	38·74	...
ARGYLL—(MAINLAND.)						
Castle Toward	Mr. McIntosh	6	4 0	65	45·60	188
Lochgilphead(Kilmory) *Thom's g.*	Sir J. P. Orde, Bart....	6	0 4	100	57·20	228
„ „ *(bottle gauge)*	„ „ „	5	0 4	100	58·80	..
„ (Callton Môr)	Mr. J. Russell	3	4 6	65	55·93	232
Lochgoilhead (Upper Glencroe)	A. McDowall, Esq. ...	3	0 6	400	121·50	...
Loch Fyne (Cairndow No. I.) ...	„ „ ...	3	0 5	30	89·09	...
„ „ („ No .II.)...	„ „ ...	8	0 5	30	86·63	...
„ „ (Glen Fyne)	„ „ ...	6	0 6	50	78·25	...
Inverary Castle	Mr. J. Caie	4	0 1	30	64·00	...
Melfort	A. Buchan, Esq.	...	...	...	74·44	...
Dalmally (Bridge of Orchy)	A. McDowall, Esq. ...	3	1 0	600 ?	119·70	...
Appin (Aird's)	R. Macfie, Esq	6	0 3	15	56·80	235
Loch Eil (Corran)	Bd. of Northern Lights	...	0 4	14 ?	78·38	...
Ardnamurchan	„ „ „	...	3 6	82 ?	35·86	...
„ (Camusinas)	J. J. Dalgleish, Esq ...	5	0 2	11	75·52	220
ARGYLL—(INSULAR.)						
Cantire, Mull of	Bd. of Northern Lights	...	...	279 ?	31·60	...
„ Campbeltown (Devaar)...	„ „ „	...	3 4	75 ?	47·17	...
Skipness Castle	Mrs. Graham	6	1 0	12	32·40	...
*Islay (Eallabus)	R. Ballingal, Esq.	6	1 0	71	47·96	237
„ (Rhinns)	Bd. of Northern Lights	..	3 0	74 ?	31·24	...
„ (Mc Arthurshead)	„ „ „	..	0 4	106 ?	61·60	...
„ (Rhu Vaal)	„ „ „	..	...	...	79·50	...
Jura (Lowlandmansbay)	„ „ „	..	...	...	49·07	...
Lismore (Mousedale)	„ „ „	..	3 4	37 ?	34·27	...
„ (Glengorm)	A. T. Forsyth, Esq. ...	6	0 9	200	48·60	...
„ (Sound of Mull)	Bd. of Northern Lights	...	0 6	12 ?	78·20	...
Tyree (Hynish)	„ „ „	...	...	...	66·63	...
BA* „ (Heynish Farm)	L. Macquarie, Esq. ...	5	0 9	60	38·44	225

DIVISION XVI.—EAST MIDLAND COUNTIES.

CLACKMANNAN.						
Dollar	Mr. Westwood	7	0 6	170	35·86	91
KINROSS.						
Loch Leven Sluice	Mr. P. Farnie	...	0 10	...	31·10	...
FIFE.						
Burntisland	Rev. G. H. Forbes ...	...	...	...	20·19	147
Dunfermline (Craigluscar)	W. Chisholm, Esq	10	0 10	400	34·20	...
Balfour	Mr. J. Dewar	3	0 6	129	24·29	126
Leven (Nookton)	W. McG. Miller, Esq.	5	0 6	80	24·98	160

DIVISION XVI.—EAST MIDLAND COUNTIES—(*con.*)

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter	Rain Gauge. Height Above Ground.	Rain Gauge. Height Above Sea Level	Depth of Rain. 1869	Days on which ·01 or more fell.
			ft. in.	feet.	inches.	
FIFE—(*con.*)						
Isle of May	Bd. of Northern Lights	...	2 2	182 ?	18·15	...
St. Andrews (Cambo House)	Sir T. Erskine, Bt.	...	0 8	50	20·80	...
Cupar (Birkhill)	Mrs. Wedderburn	5	0 5	130	24·74	...
PERTH.						
Culross (West Grange)	J. J. Dalgleish, Esq.	5	0 2	116	26·86	108
Menteith (Cardross House)	Mr. Wyber	8	1 0	120	42·50	...
Aberfoyle	Glasgow Water Works	8	0 6	60	59·90	...
Dunblane (Kippenross)	J. Stirling, Esq.	6	0 4	100	31·80	...
Deanston House	J. Finlay, Esq.	6	0 4	130	40·51	190
Loch Dhu	Glasgow Water Works	8	0 6	325	79·80	...
„ Drunkie	„ „ „	8	0 6	420	59·80	...
„ Vennachar	„ „ „	8	0 6	275	53·50	...
Lanrick Castle	A. Glover, Esq.	3	0 0	...	42·25	134
Bridge of Turk	Glasgow Water Works	8	0 6	270	59·90	...
Loch Katrine (Tunnel Hill Top)	„ „ „	8	0 6	830	73·40	...
Callander (Leny)	J. B. Hamilton, Esq.	3	0 3	345	59·30	...
Between Glen Finlas & Ben Ledi	Glasgow Water Works	8	0 6	1800	45·20	...
Glen Gyle	„ „ „ ...	...	...	380	91·00	...
Auchterarder House	Colonel Hunter	8	2 3	162	30·10	...
Crieff (Muthill)	Rev. A. J. T. Morris	3	1 0	247	43·02	191
Auchterarder (Colquhalzie)	J. S. Hepburn, Esq.	8	0 5	150	35·36	...
„ (Trinity Gask)	Mr. R. Wylie	3	0 1	133	31·31	139
Loch Earnhead (Stronvar)	A. Buchan, Esq.	3	0 4	460	76·18	...
Perth Academy	Dr. Miller, F.R.S.E.	15	64 5	79	22·85	...
„ (Inchbank)	„ „ ...	10	1 6	20	28·89	...
„ (Early Bank)	Mr. McGlashan	12	0 3	66	? 28·04	...
Scone Palace	Mr. J. Halliday	6	2 6	80 ?	24·72	94
Glen Almond (Logie Lodge)	Mr. J. Stewart	2	4 6	1500	41·00	...
Meigle (Belmont Castle)	Mr. J. Davidson	8	37 0	237	24·80	...
Blairgowrie (Rosemount)	R. Geekie, Esq.	8	6 1	300	25·98	134
Aberfeldy (Bolfracks)	J. F. Wyllie, Esq.	12	0 6	360	42·40	...
„ (Blackhill)	J. S. Hepburn, Esq.	3	0 3	820	34·87	...
*Logierait (Strath-tay)	Rev. G. D. R. Munro	5	1 0	313	29·45	156
FORFAR.						
†Dundee (Hermon Hill)	R. Adamson, Esq.	11	0 0	116	26·19	...
† „ (Westfield Cottage)	C. Clark, Esq.	5	5 6	50	23·61	168
† „ (Eastern Necropolis)	Mr. W. R. McKelvie	3	0 5	167	? 24·65	114
„ (Clepington)	‡Dundee Water Works	...	...	338	24·25	...
†Barry Village	Mr. J. Proctor	12	0 3	35	? 25·87	192
†Craigton	Dundee Water Works	11	0 3	481	30·07	...
†Crombie Reservoir	„ „ „ ...	11	0 3	522	31·21	...
Kettins	Mr. J. Gibb	4	1 0	218	30·73	120
†Hill Head	Dundee Water Works	11	0 3	570	30·82	...
Arbroath	A. Brown, Esq.	8	2 0	61	23·73	122
Montrose (Bridge Street)	D. Scott, Esq.	11	0 3	25	22·67	...
„ (High Street)	Mr. W. Leighton	7	6 4	22	19·54	...
„ (Sunnyside Asylum)	A. Buchan, Esq.	...	...	200	34·87	...

‡ Information supplied by J. Duncan Esq.

DIVISION XVII.—NORTH EASTERN COUNTIES.

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Rain Gauge. Height Above Ground.	Rain Gauge. Height Above Sea Level	Depth of Rain. 1869	Days on which 01 or more fell.
			ft. in.	feet.	inches.	
KINCARDINE.						
Lawrencekirk (Johnstone Lodge)	A. Buchan, Esq.....	...	...	...	34·35	...
Brechin (The Burn)	Col. McInroy	6	0 6	237	30·10	...
Fettercairn	Mr. A. C. Cameron ...	3	0 3	225	30·05	215
„ (Arnhall)	J. Vallentine, Esq.....	6	0 2	200	29·40	...
Girdleness [Aberdeen]	Bd. of Northern Lights	...	4 7	86	24·83	...
ABERDEEN.						
Braemar	Mr. J. Aitken	8	0 9	1114	31·66	169
Ballater	J. W. Paterson, Esq...	5	0 9	656	30·27	176
Drumoak (Drum Castle) *monthly*	Mr. G. Gammie.....	5	1 8	275	37·03	...
Cromar (Coldstone)	Rev. J. G. Michie	5	4 0	608	24·28	122
Aberdeen (Pitmuxton)	Mr. J. Taylor.....	10	1 4	14	31·23	187
† „ (Rose Street).....	A. Cruickshank, Esq...	8	0 4	95	29·07	...
* „ (Skene St.)	Rev. A. Beverly	5	4 8	107	31·70	194
„ „ „ *monthly*	„ „ „	5	4 8	107	32·64	...
„ (Grammar School) „	„ „ „	5	2 0	95	33·76	...
„ („ „) „	„ „ „	5	8 6	103	26·15	...
„ („ „) „	„ „ „	5	63 10	161	25·65	...
„ (Wallfield) „	„ „ „	5	3 4	163	30·87	...
Midmar (Blackstock).....	Mr. J. Barron	5	0 8	500 ?	29·74	187
Lumphanan (Corse House)	Mr. J. Hay.....	5	3 0	833	28·57	188
BA*Alford (Bogside, Leochel) ...	W. Bruce, Esq.	5	3 0	882	32·26	197
Strathdon (Castle Newe)	Mr. A. Walker	5	1 0	915	29·81	203
Inverury (Kenmay)	Rev. G. Peter.....	8	0 0	300	35·05	...
„ „	„ „ „	8	0 7	300	30·60	...
„ (Manse)	Rev. J. Davidson	9	0 2	220	34·69	...
Ellon (Tillydesk)	Mr. W. Hay	11	0 4	349	35·42	...
Peterhead (Buchanness)	Bd. of Northern Lights	...	3 4	35?	27·23	...
Old Deer (Manse)	Rev. J. Peter	8	0 8	154	32·04	...
Turriff (New Byth).....	A. Henderson, Esq. ...	5	0 5	391	41·28	...
New Pitsligo	Mr. D. Sturrock	3	0 3	501	39·01	203
Kinnairdhead	Bd. of Northern Lights	...	3 4	64?	31·24	...
BANFF.						
Rothiemay	Mr. G. Murdoch	8	1 6	275	34·83	...
Gordon Castle.....	Mr. Webster	8	1 6	70	30·84	...
ELGIN OR MORAY.						
Elgin (Ashgrove)	W. Topp, Esq.	8	0 3	33	28·42	173
„ (Institution).....	A. Buchan, Esq.....	...	...	...	28·61	...
Covesea Skerries.....	Bd. of Northern Lights	...	...	...	20·07	...

DIVISION XVIII.—NORTH-WESTERN COUNTIES.

WEST ROSS.‡							
*Loch Alsh (Inverinate House) ...	Mrs. Matheson	5	3	0	150	69·12	156
BA*Applecross.....	Dr. Haynes	5	1	0	50	67·69	239
Lochbroom (Loch Drome).....	J. W. Baldry, Esq. ...	...	0	5	850	62·15	...
BA* „	Mr. M. Macleay	5	0	8	47	52·83	22

‡ Including Cromarty.

DIVISION XVIII.—NORTH-WESTERN COUNTIES—(*continued*).

STATIONS.	AUTHORITIES.	Rain Gauge. Diameter.	Rain Gauge. Height Above ground	Rain Gauge. Height Above Sea Level	Depth of Rain 1869	Days on which ·01 or more fell.
			ft. in.	feet.	inches.	
WEST ROSS—(*con.*)						
Isle of Lewis (Stornoway)	Bd. of Northern Lights	...	3 4	31 ?	29 03	...
„ (Lewis Castle)	Mr. Smith	5	0 8	60	?22·00	18
„ (Bernera)	Mr. J. Macdonald	5	0 6	18	87·05	...
„ (Butt of Lewis)	Bd. of Northern Lights	...	3 6	...	45·65	...
EAST ROSS.‡						
Brahan Castle	K. S. McKenzie, Esq.	5	0 9	300	30·78	161
BA*Dingwall Academy	J. Boyd, Esq.	5	0 11	22	27·37	156
Cromarty	Bd. of Northern Lights	...	3 4	28 ?	20·05	...
*Invergordon Castle	B. B. Æ. McLeod, Esq.	5	3 0	20	24·57	151
Alness (Ardross Castle)	Mrs. Matheson	5	1 0	450	38·81	201
BA*Tain (Fearn)	Mr. M. McLean	5	1 3	48	26·14	172
„ (Springfield)	Mr. McLardy	5	1 2	80	29·50	191
Tarbetness	Bd. of Northern Lights	...	3 4	61 ?	16·45	...
WEST INVERNESS.						
Loch Nevis (Inverie)	Mr. N. Macdonald	5	2 6	18	82·60	...
Knoydant (Glen Quoich)	Mr. Ballingall	7	4 0	560	84 53	...
Isle of Skye (Oronsay)	Bd. of Northern Lights	...	0 6	15 ?	70·70	...
„ (Kyle Akin)	„ „ „	...	0 2	3 ?	81·80	...
„ (Raasay)	Mr. T. Bunning	12	1 4	80	82·55	155
BA* „ (Portree)	Mr. J. Grant	5	1 8	85	89·30	249
„ (Rona)	Bd. of Northern Lights	...	0 6	196 ?	34·41	...
Barrahead	„ „ „	...	3 0	640 ?	27·19	...
S. Uist (Ushenish)	„ „ „	...	0 4	157 ?	42·08	...
N. Uist (Monach)	„ „ „	...	...	...	45·10	...
„ (Spanish, Loch Maddy)	Sir J. P. Orde, Bt.	...	...	...	49·74	...
Harris (Island Glass)	Bd. of Northern Lights	...	3 4	50 ?	46·37	...
EAST INVERNESS.						
BA*Laggan	Mr. A. McIntosh	5	0 9	821	59·26	212
Strath Errick (Farraline House)	Capt. Fraser	3	0 9	700	41·30	...
Glen Urquhart (Corrimony)	T. Ogilvy, Esq.	4	0 6	550	46·50	171
Strathspey (Grantown)	Mr. W. Duncan	5	1 2	712	33·54	178
*Beauley (Beaufort Castle)	Mr. W. Anderson	5	0 8	60	31·53	144
Inverness (Culloden House)	A. Forbes, Esq.	...	3 0	104	25·66	...
Glen Strathfarrer	Mr. D. Fraser	5	1 0	500	68·17	237

DIVISION XIX.—NORTHERN COUNTIES.

SUTHERLAND.						
BA*Invershin	Mr. G. Young	5	4 0	20	29·47	...
Golspie (Dunrobin Castle)	Mr. J. Mitchell	3	0 3	6	28·55	181
BA*Helmsdale	Mr. J. Campbell	5	1 0	34	35·56	...
Scourie	A. Buchan, Esq.	...	...	26	52·19	...
House of Tongue	J. Crawford, Esq.	4	0 1	33	43·80	242
Cape Wrath	Bd. of Northern Lights	...	3 6	355 ?	40·58	...
CAITHNESS.						
Wick (Pulteney House)	Capt Rutherford, R.N.	5	3 8	70	31·56	171

‡ Including Cromarty.

DIVISION XIX.—NORTHERN COUNTIES—(*continued*).

STATION.	AUTHORITIES.	Rain Gauge.			Depth of Rain.	Days on which ·01 or more fell.
		Diameter.	Height Above Ground.	Height Above Sea level	1869.	
			ft. in.	feet.	inches.	
CAITHNESS—(*con.*)						
Wick (Nosshead)	Bd. of Northern Lights	...	3 4	127 ?	28·35	...
Thurso (Holburnhead)	„ „ „	...	0 4	60 ?	34·34	...
Dunnethead	„ „ „	...	3 6	300 ?	18·93	...
Pentland Skerries	„ „ „	...	3 3	72 ?	29·75	...
ORKNEY.						
South Ronaldsay (Roeberry)	J. Gray, Esq	5	1 2	150	30·82	224
Hoy (Cantickhead)	Bd. of Northern Lights	...	...	...	32·87	...
„ Graemsay Sound (East)	„ „ „	...	3 4	27 ?	38·85	...
„ „ (West)	„ „ „	...	...	37 ?	33·83	...
ℬ*Pomona (Holm Manse)	Rev. O. Scott	5	1 4	30 ?	35·71	...
† „ (Kirkwall)	Mr. J. G. Iverach	3	0 4	8	35·84	225
Shapinsay (Balfour Castle)	D. Balfour, Esq	3	0 3	50	38·20	...
†Pomona (Sandwick)	Rev. C. Clouston, LL.D.	11	2 0	78	43·43	253
Stronsay (Auskerry)	Bd. of Northern Lights	...	...	...	27·20	...
Sanda (Start Point)	„ „ „	11	0 6	29 ?	44·11	...
ℬ*Papa Westray	Rev. C. Clouston, LL.D.	5	...	80 ?	34·80	...
North Ronaldsay	Bd. of Northern Lights	...	3 4	21 ?	30·44	...
SHETLAND.						
Sumburghead	Bd. of Northern Lights	...	3 4	265 ?	27·64	...
Bressay Lighthouse	„ „ „	5	0 4	60	30·86	...
„ Manse ..... *monthly*	Rev. Dr. Hamilton	8	0 8	10	40·50	268
ℬ*East Yell	Mr. A. D. Mathewson	5	1 0	176	49·77	300

IRELAND.

DIVISION XX.—MUNSTER.

STATION.	AUTHORITIES.	Rain Gauge. Diameter.	Height Above Ground. ft.	in.	Height Above Sea level feet.	Depth of Rain. 1869. inches.	Days on which 01 or more fell.
CORK.							
Cork (Queen's College)	Professor England	10	6	0	65	40·96	180
,, (Royal Institution)	Dr. Caulfield	10	50	0	70	32·55	138
Fermoy	A. Campbell, Esq.	10	4	0	114	34·65	179
Mallow (Woodfort)	G. S. Ware, Esq.	5	5	6	205	39·73	209
KERRY.							
Knightstown (Valentia)	The Knight of Kerry	8	1	2	10	54·55	249
BA*Killarney (Kenmare Gardens)	Mr. Breese	12	4	0	24	59·47	196
WATERFORD.							
Waterford (Newtown)	Mr. R. J. Greer	12	4	0	60?	37·40	193
TIPPERARY.							
Carrick-on-Suir (Deer Pk. Lodge)	J. Ernest Grubb, Esq.	5	1	2	150	34·07	187
Clonmel (Glenam)	Miss Grubb	5	1	10	80	39·54	212
,, (Bruce Villa)	J. H. Grubb, Esq.	5	1	6	110	36·21	205
Tipperary (Ballykisteen)	Jasper Bolton, Esq.	5	1	1	350	39·76	...
BA*Borrisoleigh (Ballinlonty)	Mr. Kearns	5	1	2	...	35·16	93
LIMERICK.							
Limerick (New Barracks)	Serjt. M'Lea	8	1	0	84	39·23	223
CLARE.							
Killaloe	Rev. C. Mayne	10	5	0	123	50·57	229

DIVISION XXI.—LEINSTER.

WEXFORD.							
Wexford (Reclaimed Lands)	C. W. Palliser, Esq.	10	0	2	1	33·06	134
New Ross (Rosbercon Cas.)	A. E. Graves, Esq.	6	2	6	45	38·69	141
Enniscorthy (Ballyhyland)	J. Moffat, Esq.	5	1	0	420?	41·93	214
Goree (Courtown)	Earl of Courtown	5	3	0	80?	34·00	180
KILKENNY.							
New Ross (Tullogher)	D. A. Milward, Esq.	5	1	0	500	41·63	...
Inistogue (Woodstock)	Rt. Hon. W. F. Tighe	5	4	6	400	38·22	181
BA*Stoneyford (Inisnag)	Rev. J. Graves	5	1	0	200	30·90	204
CARLOW.							
Bagnalstown (Fenagh)	R.C.Browne, Jun. Esq.	5	1	0	340	32·40	187
Carnew (Coollattine Park)	Mr. Byrne	5	1	0	427	24·05	...
Carlow (Browne's Hill)	R. C. Browne, Jun., Esq.	5	1	0	291	35·78	225

DIVISION XXI.—LEINSTER—(*continued.*)

STATION.	AUTHORITIES.	Rain Gauge. Diameter	Height Above Ground. ft.	in.	Height Above Sea level feet.	Depth of Rain. 1869. inches.	Days on which ·01 or more fell
QUEEN'S COUNTY.							
Portarlington	Dr. Hanlon	5	1	2	736	30·05	252
KING'S COUNTY.							
Roscrea (Cangort Park)	H. B. Trench, Esq.	5	8	0	340	31·81	190
Parsonstown (Birr Castle)	Hon. R. Parsons	4	0	3	200	35·56	182
Tullamore	H. J. B. Kane, Esq.	10	3	0	235	28·46	211
WICKLOW.							
Bray (Fassaroe)	E. Barrington, Esq.	10	5	0	250	38·96	168
DUBLIN.							
Black Rock (Rockville)	T. Bewley, Esq.	12	29	0	90	29·69	126
Dundrum (Bloomsbury)	J. Wensley Bond, Esq.	5	1	1	268	30·52	...
Monkstown (Easton Lodge)	Greenwood Pim, Esq.	3	1	1	70 ?	28·05	189
Dublin (Phœnix Park)	Capt. Wilkinson, R.E.	31	10	0	169	28·46	192
" " "	" " "	13	3	0	162	27·57	192
" (FitzWilliam Square)	Dr. J. W. Moore	5	3	0	54	27·56	185
" (Glasnevin)	Dr. D. Moore	...	9	0	65	26·14	170
BA*Skerries	Rev. T. Greene	5	1	0	12	29·92	214
Balbriggan	Rev. S. P. Warren	5	1	0	40	31·08	211
LOUTH.							
Castle Bellingham (Drumcashel)	Mrs. Macan	8	1	4	225	28·23	185

DIVISION XXII.—CONNAUGHT.

GALWAY.							
Gort (Cregg Park)	R. J. Lattey, Esq.	5	3	0	120	42·05	188
Galway (Queen's College)	Prof. Curtis, LL.D.	10	6	0	25	52·19	224
Ballinasloe	J. Kempster, Esq.	...	...		150 ?	41·32	144
Tuam (Gardenfield)	H. Kirwan, Esq.	...	6	0	...	37·20	...
ROSCOMMON.							
BA*Hollywell	H. Smyth, Esq.	5	5	6	...	33·73	...
SLIGO.							
BA*Buninnadden (Doo Castle)	Mr. D. O'Dowd	5	1	0	...	42·84	230
Collooney (Markree Observatory)	Col. Cooper	24	16	3	145	39·45	205
Sligo (Haslewood)	Miss Wynne	2	2	4	47	40·31	179
" (Mount Shannon)	F. M. Olpherts, Esq.	9	4	5	70	48·79	219

DIVISION XXIII.—ULSTER.

CAVAN.							
BA*Bawnboy (Owendoon)	G. H. L'Estrange, Esq.	5	1	3	218	43·73	230
" " *monthly*	" " "	5	1	2	218	43·66	...
*Belturbet (Red Hills)	Rev. E. Whyte Venables	5	0	9	...	31·92	230
FERMANAGH.							
Enniskillen (Florence Court)	Earl of Enniskillen F.R.S.	12	11	0	300	44·48	...
ARMAGH.							
Armagh Observatory	Rev. Dr. Robinson F.R.S.	10	1	5	208	29·64	158
DOWN.							
Ardglass Castle	De Vere Beauclerck, Esq.	...	0	9	50	30·16	129

DIVISION XXIII.—ULSTER—(*continued*).

STATION.	AUTHORITIES.	Rain Gauge. Diameter	Height Above Ground. ft.	in.	Height Above Sea level feet.	Depth of Rain. 1869. inches.	Days on which '01 or more fell
DOWN—*con.*							
Seaforde	Colonel Forde, M.P.	8	0	5	180	33·59	205
Milltown (Bann Res)	J. Smyth, Esq. C.E.	8	1	0	440	28·90	102
Banbridge (Milltown)	" " "	8	0	8	200	29·33	195
" "	" " "	12	40	0	220	25·31	...
Waringstown	Capt. Waring	8	0	4	190	30·40	192
" (*monthly*)	" "	2	0	4	190	29·21	...
ANTRIM.							
Lisburn (Aghalee)	Lancelot Turtle, Esq.	5	1	0	105	28·82	181
†Belfast (Queen's College)	Mr. W. Taylor	11	7	4	68	32·57	175
† " (Linen Hall)	J. Stephens, Esq.	11	4	0	12	35·44	202
" (Old Park)	W. Girdwood, Esq.	6	4	0	224	42·79	225
" (Antrim Road)	Mr. A. Moore	6	7	3	144	32·08	...
" (Sydenham)	R. Reade, Esq.	5	1	1	60	32·20	216
BA*Antrim (The Manse)	Rev. J. H. Orr	5	1	0	150	26·66	150
Ballymoney	E. H. Knox, Esq.	5	7	0	170	36·64	240
Cushendall (Agolah)	Rev. S. A. Brenan	5	7	0	160	34·22	...
LONDONDERRY.							
*Garvagh (Moneydig)	H. R. Morrison, Esq.	5	1	0	121	40·00	209
Londonderry	D. Watt, Esq.	8	0	3	80	39·75	...
Bellarena	SirF.Heygate,Bt.,M.P.	5	1	0	12	36·73	222
TYRONE.							
Omagh (Edenfell)	Captain Buchanan	8	1	0	300	33·25	242
Strabane (Leckpatrick)	Rev. C. Maxwell	8	0	5	253	41·87	253
DONEGAL.							
BA*Letterkenny	Rev. Dr. Kingsmill	5	1	8	108	52·86	...
Dunglow (Templecrone)	Rev. A. Delap	8	0	6	10	45·86	245

G. J. S.

FINANCIAL.

THERE is nothing specially worthy of note on this subject. The observations, and the published results thereof, must still be regarded as a voluntary gift to the public by the observers, many of whom (as will be seen from the following list) not only give the time required for observing, but also contribute towards the expenses of publication. The British Association must also be acknowledged as joining in the gift, since they have for some years past contributed £50 per annum towards certain special objects. And lastly, the Editor may claim a share in the credit, since in many years he has, in return for work of which it is not for him to speak, received less pecuniary profit than an ordinary clerk.

The general public, and those engineers whose share in the work is confined to paying five shillings for a copy of the Annual Tables, can hardly be aware of the fact, that if the present voluntary association is inadequately supported, or attempted to be displaced, the system of registration which does not now cost the country a farthing, could only be imperfectly perpetuated at an expenditure exceeding £12,000 per annum.*

* See a paper by J. Bailey Denton, Esq., C.E., *Journal of Society of Arts*, January, 1858.

List of all Sums of £1 *and upwards, received in payment for Books, Diagrams, &c., or as contributions to the general expenses of Rainfall investigations in* 1870.

	£	s.	d.
Abbotts, R. W., Esq.	1	15	0
Ainsworth, R. H., Esq.	1	13	0
Aire & Calder Navigation Co...	1	11	0
Appach, R., Esq.	1	0	0
Assheton, R., Esq., M.P.	1	0	0
Atkinson, A., Esq.	1	0	0
Backhouse, C. J., Esq.	1	0	0
Backhouse, T. W., Esq.	1	0	0
Baker, W. C., Esq.	1	1	0
Balme, E. B. W., Esq.	1	1	0
Barrington, E., Esq.	1	0	0
Barter, C. S., Esq., M.D.	1	0	0
Bathurst, Rev. W. H.	1	0	0
Baylis, H., Esq.	1	1	0
Bayning, The Lady	1	1	0
Bewley, T., Esq.	1	0	0
Bicknell, P., Esq.	1	11	0
Birkbeck, W., Esq.	1	0	0
Birkett, Rev. T.	1	0	0
Blake, W., Esq	1	0	0
Bodenham, J., Esq.	1	10	0
Bolckow, H. W. F., Esq., M.P.	1	10	0
Bosanquet, S., Esq.	1	0	0
Bower, G., Esq.	1	6	0
Box, A. M., Esq.	1	5	0
Bravender, J., Esq.	1	5	0
Bridgeman, Hon. & Rev. J.R.O.	1	1	0
Bristol Water Works Company	1	1	0
Brooke, The Rev. J.	1	0	0
Brown, A. L. D., Esq.	1	0	0
Brown, Captain	1	0	0
Brown, T. C., Esq.	1	0	0
Buchanan, Captain	1	0	0
Bumpstead, The Rev. T. J.	1	0	0
Burlingham, R., Esq.	1	14	6
Cadogan, C. H., Esq. (2 years)	1	4	0
Casella, L. P., Esq.	1	0	0
Cator, C. O. F., Esq.	1	10	0
Charrington, F., Esq.	1	0	0
Chrimes, R., Esq.	10	0	0
Clark, E., Esq.	1	0	0
Clark, Sir James, Bart., F.R.S.	1	0	0
Clay, A., Esq.	1	1	0
Clegram, W. B., Esq., C.E.	1	1	0
Collins, C. R., Esq.	1	11	0
Colquhoun, J. C., Esq.	1	0	0
Coode, W., Esq.	1	2	6
Cooke, The Rev. R. B.	1	0	0
Cooke, J. H., Esq.	1	1	0
Courtown, Right Hon. Earl of	1	5	0
Darby, C., Esq.	1	5	0
Dartnell, G. R., Esq.	1	0	0
Davis, J., Esq.	1	0	0
Davis, T. H., Esq.	1	0	0
Denne, W., Esq.	1	0	0
Dines, G., Esq.	1	0	0
Dipple, G., Esq.	1	1	0
Divett, J., Esq.	1	0	0
Dod, Whitehall, Esq.	1	10	0
Doncaster, D., Esq., Jun. (2 yrs.)	1	0	0
Doubleday, H., Esq.	1	0	0
Douglas, S., Esq.	1	0	0
Drummond, General	1	11	0
Dyke, T. J., Esq.	1	0	0
Dymond, E. E., Esq.	1	1	0
Erskine, Sir T., Bart.	1	0	0
Estlin, Captain	1	1	0
Evans, F. G., Esq.	1	6	0
Fawcett, E. G., Esq.	1	0	0
Fawcett, H., Esq.	1	0	0
Ffolkes, The Rev. H.	1	2	0
Field, Rogers, Esq., C.E.	1	11	0
Filliter, E., Esq., C.E.	1	11	0
Finlay, J., Esq.	1	10	0
Fletcher, I., Esq., M.P., F.R.S.	2	12	0
Forde, Colonel, M.P.	2	6	0
Freeman, D. A., Esq.	1	2	0
Fuller, F., Esq.	1	3	0
Gale, J. M., Esq., C.E.	1	0	0
Gamlen, W. H., Esq.	1	1	0
Giles, J., Esq.	1	0	0
Gillet, The Rev. G. E.	1	0	0
Gillow, Rev. Dr.	1	0	0
Gosset, The Rev. I. H.	1	14	0
Gott, C., Esq.	1	1	0
Graham, Mrs.	1	0	0
Graves, Rev. J. (2 years)	1	1	0
Grey, Admiral Sir F. W.	2	8	0
Grey, The Right Hon. Earl	1	0	0
Hadam, J., Esq. (2 years)	2	2	0
Hankinson, R. C., Esq.	1	0	0
Harcourt, Colonel	1	0	0
Hare, C. K., Esq.	1	0	0
Harris, W. J., Esq.	2	0	0
Harrison, W. F., Esq.	1	11	0
Harvey, H. M. Esq.	1	1	0
Healey, G., Esq.	1	3	0
Heberden, Rev. W.	1	0	0
Herbert, J. M., Esq.	1	6	0
Hill, The Rev. E.	1	1	0
Hill, J. H., Esq.	1	13	0
Holdsworth, J. S., Esq.	1	0	0
Hony, The Ven. Archdeacon	1	2	0
Hopkins, The Rev. T. A.	1	15	0
Horner, Rev. J.	1	0	0
Horrocks, W., Esq.	1	5	0
Hounsfield, Mrs.	1	0	0
Howard, W. D., Esq.	5	10	0
Howman, The Rev. E. J.	1	10	0
Hull, The Rev. J.	1	0	0
Ingram, The Rev. H.	1	11	6
Jefferson, Miss M. C. D.	1	0	0
Jenkin, S. W., Esq., C.E. (2 years)	1	10	0
Jones, Mrs.	1	3	0
Jowers, F. W. E., Esq.	1	5	0
Karslake, The Rev. W. H.	1	0	0
Ker, R., Esq.	1	1	0
Knott, J. Esq.	1	0	6

	£	s.	d.
Knowles, J., Esq.	1	0	0
Langton, S. Z., Esq.	1	10	0
Leather, J. T., Esq., C.E.	1	11	0
Legard, The Hon. Lady	2	2	0
L'Estrange, H. S., Esq.	1	0	0
Lighton, Rev. Sir C. R., Bart.	1	2	0
Lockhart, A. E., Esq.	1	0	0
Lucas, W., Esq.	1	1	0
Lund, C., Esq.	1	0	0
Mackeson, H. B., Esq.	1	15	0
Macfie, R., Esq.	5	0	0
Malden, The Rev. C.	1	5	0
Mansel, J. C. Esq.	1	0	0
Marshall, A., Esq.	2	10	0
Marshall, H. C., Esq.	3	0	0
Marshall, J. G., Esq.	3	0	0
Matheson, Mrs.	2	0	0
Mathew, Major	2	9	6
Maxwell, Rev. C.	1	0	0
Maxwell, Rev. E.	1	0	0
Melville, A. S. L., Esq.	1	1	0
Morgan, T. H., Esq.	1	0	0
Murdoch, The Rev. J. B.	1	0	0
Musgrave, W., Esq.	1	2	0
Newdigate, Rev. C.	1	0	0
Norris, T., Esq.	2	10	0
North, A., Esq.	1	1	0
Nunes, F. Esq.	1	1	0
Nutter, J., Esq.	1	1	0
Ogilvy, T., Esq.	1	1	0
Orde, Sir J. P., Bart. (2 years)	2	0	0
Osler, A. Follett, Esq., F.R.S.	1	1	0
Parkin, A., Esq.	1	5	0
Parnell, J., Esq.	1	5	0
Pasley, Admiral Sir T. S., Bt.	2	2	0
Paulin, T., Esq.	2	10	0
Paxton, H., Esq.	1	0	0
Peake, H. W., Esq.	1	0	0
Peckover, A., Esq.	1	1	0
Pennant, P. P., Esq.	1	1	0
Perry, Rev. S. J.	1	5	0
Pigott, G. Esq.	1	0	0
Preston, The Rev. T. A.	2	4	0
Prince, C. L., Esq.	1	1	0
Rainey, G., Esq.	1	1	0
Reynolds, L. W., Esq.	1	1	0
Robson, J., Esq.	1	0	0
Robson, J. W., Esq.	1	0	0
Rylands, T. G., Esq.	1	0	0
Sharpe, H., Jun., Esq.	1	10	0
Shiffner, Miss	1	0	0
Silver, S. W., Esq.	2	2	0
Slinn, W. S., Esq.	1	0	0
Smyth, J., Jun., Esq.	1	0	0
Smith, J., Esq.	2	2	0
Snow, The Rev. H.	2	0	0
Southall, H., Esq. (2 years)	1	1	0
Southall, E. P., Esq.	1	6	0
Spedding, T. S. Esq.	1	5	0
Squire, W., Esq.	1	4	6
Stephens, A., Esq.	1	10	0
Stokes, H., Esq.	1	0	0
Stone, W. H., Esq., M.P.	1	0	0
Stow, Rev. F. W.	1	0	0
Tabor, S., Esq.	1	5	0
Taylor, R., Esq.	1	1	0
Tighe, the Right Hon. W. F.	1	0	0
Tippinge, F. G., Esq.	1	0	0
Trench, H. B., Esq.	1	0	0
Trimleston, the Rt. Hon. Lord	1	0	0
Tucker, H., Esq.	1	0	0
Tuckett, F. F., Esq.	1	0	0
Turner, T., Esq.	1	7	0
Turtle, Lancelot, Esq.	1	0	0
Wagstaff, J. Esq.	1	4	0
Wallis, J., Esq.	1	0	0
Ward, Dr.	1	0	0
Ward, H., Esq.	1	0	0
Ware, G. S. Esq.	1	0	0
Waring, Captain	1	10	0
Warren, G., Esq.	1	10	6
Waterhouse, J., Esq., F.R.S.	2	2	0
Watkins, J., Esq.	1	9	0
Watson, H. H., Esq.	1	0	0
Weston, Rev. G. F.	1	0	0
Whitbread, S. C. Esq.	1	0	0
White, A. Holt, Esq.	1	0	0
White, J., Esq.	1	0	0
White, The Rev. H. Masters.	1	1	0
Wigram, J. R., Esq.	1	0	0
Wilson, T., Esq.	1	1	0
Wingfield, the Rev. C. L.	1	1	0
Winter, the Rev. E. W.	1	3	9
Wood, J. G., Esq.	1	6	0
Yonge, J. B., Esq.	1	0	0

[Subsequent receipts will be acknowledged monthly in the *Meteorological Magazine.*]

APPENDIX.

ON EVAPORATION.

WITH NOTES WRITTEN EXPRESSLY FOR THIS ARTICLE BY, OR EXTRACTED FROM THE WORKS OF—

BEVERLEY, REV. A., M.A.
BONNETAT, M.
BUIST, DR. G., F.R.S.
CASELLA, L. P., ESQ., F.R.A.S.
DALTON, DR. JOHN, F.R.S.
DANIELL, PROFESSOR, F.R.S.
DELAPORTE, M.
DINES, G., ESQ.
EATON, H. S., ESQ., M.A.
FIELD, ROGERS, ESQ. B.A., C.E.
FLETCHER, I. ESQ., M.P., F.R.S.
GLAISHER, J., ESQ., F.R.S.
GREAVES, C., ESQ., C.E.
GRIFFITH, REV. C. H.
HAUGHTON, PROFESSOR
HOWARD, LUKE, F.R.S.
LESLIE, PROFESSOR
MILLER, DR. J. F., F.R.S.
MILLER, S. H., ESQ., F.R.A.S.
MILNER, W. R., ESQ.
MITCHELL, DR.
NEGRETTI, H., ESQ.
PHILLIPPS, MAJOR
PROCTOR, MR. J.
RUINET, M.
SHARPLES, G., ESQ.
STEINMETZ, A., ESQ.
SYMONS, G. J., ESQ.
TARBÉ, M.
VALLÈS, M.
WATSON, H. H., ESQ., F.C.S.

ON EVAPORATION.

THE importance of the above subject needs no enforcement in these pages. My readers are aware that I have referred to it again and again, pointed out the inconsistency of almost all published observations, and sketched out lines of experiment which I thought might tend to produce order out of chaos. Nothing, however, came of it until during the past summer, when Mr. Rogers Field, B.A., C.E., being professionally engaged in some cases involving the question of evaporation, I had some conversation with him upon the matter, and a few preliminary experiments were commenced at Camden Square, and continued for some months. The results were of a most startling character, and abundantly proved the necessity of enlarged and varied arrangements, utterly out of my own power to continue. This being the case, we jointly drew up a paper, which was read at the Meeting of the British Association, and as it states clearly the anomalous condition of the subject, and may to a certain extent be considered as the foundation of the enquiry now in progress, I have printed it *in extenso* in the following pages

Desiring to afford my readers as complete a survey as possible of the actual state of knowledge on this subject at the close of the year 1869, I have induced Mr. Field to favour us with abstracts of some of the most important experiments made by engineers, and at the end of his communication have given an epitome of what meteorologists have done. Owing to the considerable space occupied by these three articles, it is impossible on the present occasion to describe a series of experiments on the subject, which, at the expense of the Royal Society, and by the kind assistance of Mr. Griffith, have been commenced at Strathfield Turgiss. Besides the above reason, it will be more convenient to describe the instruments next year, at the same time that we give an account of the first year's work.

ON THE DETERMINATION OF THE REAL AMOUNT OF EVAPORATION FROM THE SURFACE OF WATER.

By Rogers Field, B.A., and G. J. Symons.

The determination of the amount of evaporation from a water surface would appear at first sight a very simple problem, but that it is really by no means such is shown by the extremely discordant results arrived at hitherto by the highest authorities. To take two instances—Mr. Fletcher, M.P., F.R.S., of Tarn Bank, who is too well known as a careful observer to require that more than his name should be mentioned, and Mr. Proctor, of Barry, whom Mr. Buchan describes as one of the ablest observers of the Scottish Meteorological Society. The returns from these two stations are generally in the ratio of three to one; *e.g.*, in 1864, Tarn Bank, 44·23 in., Barry, 11·09 in.; and, in 1865, Tarn Bank, 47·86 in., and Barry, 28·65 in. The high values returned by Mr. Fletcher do not result from any oversight, because a year or two since he concluded a note on evaporators in the following words: "The mean evaporation is 47 in., a quantity vastly in excess of the amount arrived at by Mr. Howard (20 in.), and Dr. Miller (30 in.), but I believe it to be more correct than either."

Some difference might be expected in the results arrived at, in consequence of the difference of locality; but such startling differences can, we believe, only be explained by the very faulty nature of the evaporators in common use.

Professor Daniell, in his *Meteorological Essays*, refers to the ordinary evaporators in the following terms:—

"The notion that these afford the absolute measure of the quantity of water raised into the air is absurd, for the instrument can only give the amount of evaporation from the shallow body of water in the place where it has been fixed. The conditions which modify the process vary almost *ad infinitum*; they vary on the land and on the water, they vary in the sunshine and in the shade, they vary as the land is more or less clothed with vegetation, or as the water is more or less deep. The evaporating gauge, so far from representing the circumstances of those bodies which yield the great body of vapour on the earth's surface, probably does not correspond in all essential particulars with a dozen puddles in the course of the year, and the pains which are often taken to make the results tally with those of the rain gauge, or to compare the two, are wholly misdirected."

Similar condemnation has been passed by other authorities.

Professor Daniell proposes, as a substitute, two methods of calculating the amount of evaporation from observations of his dewpoint hygrometer; but he states that it depends on the observer's estimate of the force of the wind. We do not understand why the evaporation from the moistened surface of the hygrometer bulb does not proceed, *pari passu*, with that from a water surface; but, assuming it to be so, there is little probability that the force at the time of observation would be exactly the average of the day, or that it would be accurately estimated. Even Professor Daniell admits that the amount deduced by this method may exceed or fall short of the tabulated quantity to the extent of one-fourth.

We venture, therefore, to consider this plan so inaccurate as to be practically useless.

In this interim note we do not purpose discussing the various methods hitherto proposed, but not one of which has been generally adopted; even the best pattern

of evaporator, to which we shall hereafter refer as the ordinary evaporator, is not used by one observer in twenty.

The great objection to nearly all evaporators hitherto used has been their diminutive size, and the consequent fact that the pint or two of water they contain has become unduly heated, and therefore the recorded evaporation has been largely in excess of what it would have been had this artificial elevation of temperature not been produced.

The only published experiments with evaporators of large size of which we are aware, are those made some years since at Dijon, and other places on the Burgundy canal, recorded in the *Annales des Ponts et Chausées.* The evaporators used in these experiments consisted of square masonry tanks, about 8 ft. on each side, and 1 ft. 4 in. deep. They were lined with zinc so as to be perfectly watertight, and sunk in the ground. The amount of evaporation from these tanks was found to be less than half what was generally adopted by the best authorities as the evaporation in that district. Experiments were also made during one year with an evaporator 1 ft. square, by the side of the large ones, and the evaporation in this case was found to be some 50 per cent. greater in the smaller than in the larger tank.

Professor Haughton, of Trinity College, Dublin, has published in the *Proceedings* of the Royal Irish Academy, some observations on evaporation at St. Helena, by Major Phillips and Lieutenant Haughton, which, though on a smaller scale, have an important bearing on the question. These experiments were made with two different kinds of evaporators placed near each other, (1) A glass cylinder 9 in. high, and 9·85 in. in diameter fully exposed, and (2) a similar glass cylinder placed in a large tub of water, so as to have the water inside the cylinder always surrounded by water nearly the same level. In these experiments, carried on for two years, the evaporation from the exposed cylinder was found to be nearly 50 per cent. greater than that from the cylinder surrounded by water. In both the above-quoted instances, the small evaporators which gave an excessive amount of evaporation were better and less liable to become unduly heated than those ordinarily in use, which may therefore be reasonably assumed to give still more erroneous results.

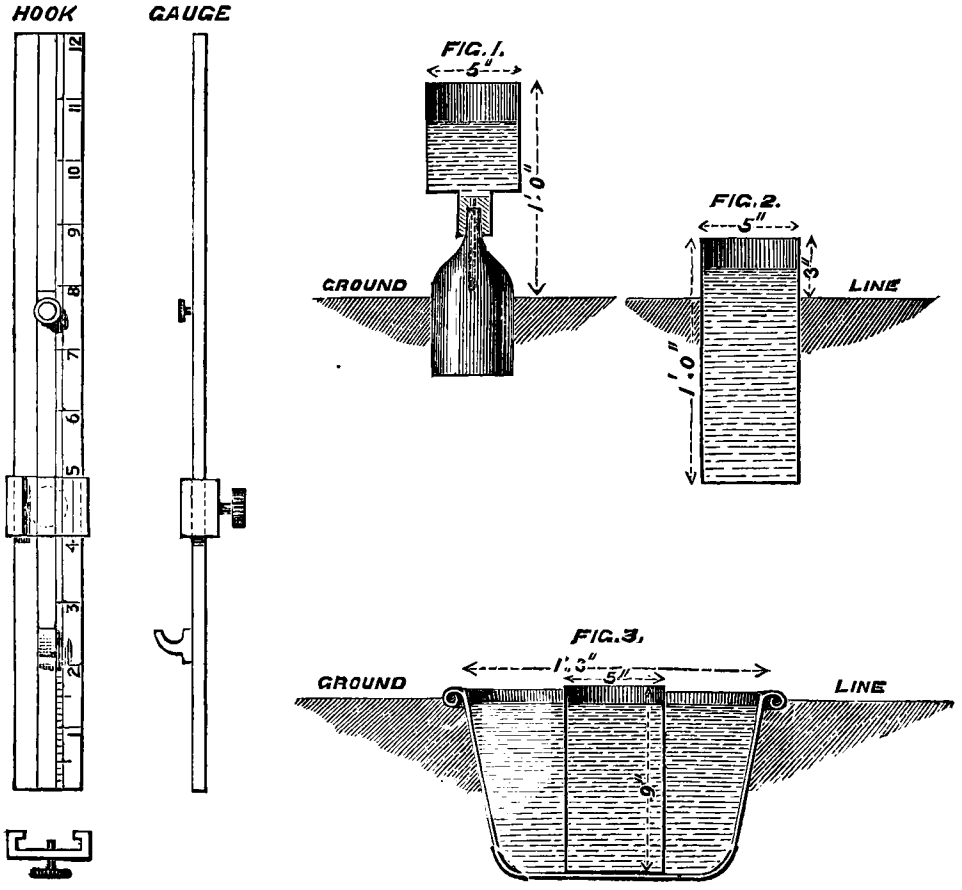
There can be no question that the most accurate method of arriving at the evaporation from a water surface is by observation on large tanks, as at Dijon ; but we cannot hope that apparatus of this kind will be used save in exceptional cases, and it therefore becomes important to devise some simple arrangement which should give approximately correct results. Our own experiments having only recently been commenced, we by no means consider that we have overcome all the difficulties of the subject ; but we desire to place on record a few facts which we hope may act as incentives to further and more complete researches on this very important subject.

One fact, which partly explains the comparative neglect into which this subject has fallen, is the difficulty of measuring accurately the quantity of water abstracted, the process usually consisting in measuring the whole volume with a graduated glass ; and this is also probably one reason for the small capacity of many of the evaporators, some holding only 1 in. deep of water.

This difficulty has been entirely obviated in our experiments by the use of a small instrument called a "hook gauge," designed some time since by Mr. Field as a portable instrument for purposes of hydraulic observations. The principle is

borrowed from an elaborate fixed arrangement described in Francis's *Lowell Hydraulic Experiments.* All other known methods of observing the height of the surface of still water are interfered with by the effects of capillary attraction, whereas this instrument owes its great precision to that phenomenon. If the point of the hook is ever so slightly raised above the water surface it raises a small cone of water with it, which is at once rendered visible by the distortion of the reflection. If, on the other hand, the point is depressed below the water, it carries the water down with it, and forms a depression, which also causes distortion of the reflection. It is, therefore, only necessary to adjust the hook, so that there shall be no distortion, and the point will then be precisely level with the surface of the water. A vernier on the slide enables the depth to be read to one-hundredth of an inch with undeviating certainty. There is a clamped bar attached, by adjusting which, and resting it on the top of the evaporator, the zero thereof can be placed in any convenient position, without the necessity of having a fixed point for the zero at the bottom of the vessel.

The arrangements we have adopted are shown on the diagram.



The following table gives the detailed results of our observations :—

Evaporation during part of July and August, 1869. *(Camden Square, London, 111 ft. above Sea Level.)*

Date of Reading.	Evaporation in hours stated.				Evaporation in 24 hours				Temperature of Water.		
	Total Hours.	1 Casella	2 Symons	3 Phillips	1 Casella	2 Symons	3 Phillips	Computed from Hygrometer.	Casella	Symons	Phillips
		in.	in.	in.	in.	in.	in.	in.	deg.	deg.	deg.
July 22, 9 a.m.	24	·18	·16	·13	·18	·16	·13	·17	82·8	77·9	74·0
,, 22, 2 p.m.	5	·19	·08	·04	..	...	...	...	95·8	86·4	82·1
,, 23, 9 a.m.	19	·18	·17	·14	·37	·25	·18	·30			
,, 24, 9 a.m.	24	·18	·15	·08	·18	·15	·08	·19	79·4	74·2	73·8
,, 25, 9 a.m.	24	·32	·25	·20	·32	·25	·20	·18	75·0	73·8	73·2
,, 25, 9 p.m.	12	·20	·11	·14	...	...	...	...	83·4	79·8	76·0
,, 26, 9 a.m.	12	·05	·06	·03	·25	·17	·17	·22			
,, 26, 1 p.m.	4	·12	·06	·05							
,, 26, 6 p.m	5	·12	·08	·04							
,, 27, 9 a.m.	15	·05	·06	·08	·29	·20	·17	·17			
,, 27, 2 p.m.	5	·16	·05	·06	...	..	...	...	82·1	77·8	73·9
,, 28, 9 a.m.	19	·11	·09	·06	·27	·14	·12	·10			
,, 29, 9 a.m.	24	·09	·12	·03	·09	·12	·03	·06			
,, 29, 1 p.m.	4	·04	·03	·02	...	...	...	...	79·2	72·2	71·8
,, 30, 9 a.m.	20	·20	·12	·12	·24	·15	·14	·15			
,, 30, 7 p.m.	10	·11	·06	·06							
,, 31, 9 a.m	14	·05	·04	·03	·16	·10	·09	·16			
Aug. 1, 9 a.m.	24	·12	·12	·11	·12	·12	·11	·12	80·4	76·1	73·0
,, 1, 1 p.m.	4	·08	·05	·02							
,, 1, 6 p.m.	5	·09	·07	·04							
,, 2, 9 a.m.	15	·07	·07	·08	·24	·19	·14	·14			
,, 2, 3 p.m.	6	·11	·06	·06							
,, 3, 9 a.m.	18	·02	·04	·03	·13	·10	·09	·11			
,, 4, 9 a.m.	24	·08	·06	·00	·08	·06	·00	·10			
,, 5, 9 a.m.	24	·19	·08	·10	·19	·08	·10	·16			
,, 5, 2 p.m.	5	·07	·05	·02	...	...	...	...	72·0	68·1	70·2
,, 6, 9 a.m.	19	·10	·10	·12	·17	·15	·14	·21	76·4	71·3	69·5
,, 6, 6 p.m.	9	·07	·06	·05							
,, 7, 9 a.m.	15	·06	·04	·03	·13	·10	·08	·21			
,, 7, 5 p.m.	8	·13	·11	·05							
,, 8, 9 a.m.	16	·06	·06	·07	·19	·17	·12	·11			
,, 9, 9 a.m.	24	·04	+·01	+·01	·04	+·01	+·01	·06			
,, 10, 9 a.m.	24	·31	·21	·16	·31	·21	·16	·15			
,, 11, 9 a.m.	24	·27	·17	·13	·27	·17	·13	·18			
,, 12, 9 a.m.	24	·15	·10	·09	·15	·10	·09	·14			
Total		4·37	3·13	2·46	4·37	3·13	2·46	3·39			
Ratio					1·78	1·27	1·00	1·38			

Fig. 1 represents, perhaps, one of the best forms of ordinary evaporators, many of those used even by the highest authorities (such as Luke Howard) being much more objectionable. It will be seen that it consists of a copper vessel containing about a quart of water exposed to direct and reflected heat on every side, and even

on the bottom, so that if it were required to obtain the maximum temperature to which that volume of water could be raised by the solar beams, the arrangements could hardly be improved upon.

Fig. 2 represents an arrangement designed by Mr. Symons some months since wherein the vessel, still of metal, is sunk almost wholly into the ground, so as to obviate as far as possible artificial heating.

Fig. 3 is a modification of the plan adopted by Major Phillips at St. Helena, and already referred to. In this the water to be measured is contained in a glass cylinder, which is placed in the centre of a much larger vessel of water, the whole being buried in the earth up to the brim of the large vessel.

It would be quite premature to draw definite conclusions from the short period of observation hitherto elapsed, but we may point out a few remarkable results.

1. During the three weeks ending August 12th, the total evaporation from Fig. 1 was 4·37 in. ; from Fig. 2, 3·13 in. ; and from Fig. 3, 2·46 in, numbers which are to each other in the ratio of 1·78, 1·27, and 1·00. Fig. 1 therefore lost 78 per cent. more water by evaporation than Fig. 3.

2. During the day-time the sunshine heats Figs. 1 and 2 to such an extent that the ratios of evaporation become about 250, 150, and 100.

3. During the night there are indications of a slight addition to Fig. 3 from condensed vapour.

4. It will be seen that the evaporation as computed from the hygrometer bears no regular relation to any of the others, being sometimes greater than any of them and sometimes less.

We have already pointed out that we consider the accuracy of an evaporator is largely dependent on its capabilities of retaining the temperature of the contained water at as nearly as possible that of large volumes of water, such as reservoirs, rivers, and ponds. Hitherto we have not been able to institute regular comparisons of the temperature of the water in our experimental vessels with that of the surface of large bodies of water. Surface temperature alone is concerned, because therefrom alone can evaporation take place. On the few instances when we have done so we have found that the water in the water-surrounded glass cylinder (Phillips, Fig. 3) has been nearly identical with that of a rather shallow reservoir one acre in extent. We do not, however, consider our observations sufficiently numerous to prove this. They, however, abundantly prove the faulty nature of all ordinary evaporators, for we find the average temperature at about 2 p.m., to have been in Fig. 1, 80°·7 ; Fig. 2, 75°·8 ; Fig. 3, 73°·8 ; showing an average excess of 7° in the temperature of Fig. 1 over that of Fig. 3. In sunshine there is an excess of twice that amount ; in fact, at times the metal becomes so hot as to scorch the hand. Before leaving the subject of temperature we may mention a singular and suggestive fact. The average excess of the temperature in the three vessels above 65° is respectively 15°·7, 10°·8, and 8°·8 ; and these values are to one another in the ratio of 1·78, 1·23, and 1·00, or nearly identical with the ratios of the amount of evaporation, viz., 1·78, 1·27, and 1 00.

We commenced this paper by placing in juxtaposition the values assigned by two high authorities in our own country, of which one was thrice the other. We can hardly more strongly advocate the claims of this question to investigation than by quoting, in conclusion, M. Vallès, the French engineer, who first called attention to the great discrepancy between the observations on the canal of Burgundy and the data generally adopted in France by scientific men. M. Vallès

says—"We do not understand how in a country like ours, and with reference to one of the most important of hydraulic data, we can rest content with only knowing that the numerical value to be attributed to this datum, so essential for a large number of engineering works, lies between two limits, one of which is double the other!"

POSTSCRIPT TO PAPER READ AT BRITISH ASSOCIATION.

The observations referred to in the above paper were continued till the latter part of November, when the instruments were taken up for removal to Strathfield Turgiss. The following are the chief results:—

Date, 1869.	Evaporation.		
	No. 1 Casella.	No. 2 Symons.	No. 3 Phillips
	in.	in.	in
August 13th to 31st	3·63	3·36	2·59
September, entire month..	4·74	4·22	2·93
October ,, ,,	2·19	2·09	1·05
November 1st to 19th.....	·82	·77	·69
Total	11·38	10·44	7·26
Ratio	157	144	100

If we add these results to those given in the paper, we get for the total evaporation from July 22nd to November 19th, a period of 121 days—

No. 1.....Casella .....15·75 inches
No. 2.....Symons .....13·57 ,,
No. 3.....Phillips ..... 9·72 ,,

Numbers which are to one another in the ratio of 162, 140, and 100, respectively.

NOTES ON EVAPORATION FROM A WATER SURFACE.

By Rogers Field, B,A., Assoc. Inst., C.E.

Being short abstracts of three papers in the Annales des Ponts et Chaussées.

And a Note on Experiments by Mr. Greaves, C.E., *at Lea Bridge.*

Note sur une exception remarquable qui présente la mesure de l'évaporation naturelle à Saint-Jean-d^e-Losne, Dijon, Pouilly, et la Roche sur Yonne. Par M. F. Vallès. (Annales 2^e série, Tom. 20, p. 383). 1850.

The amount of evaporation at any place in France is generally considered by hydraulic engineers to be greater than the rainfall there. During a practice of 20 years, specially directed to hydraulic works,

I have never known an exception to this. In Paris the evaporation is reckoned at 51·2 to 59 in., and the rain at 19·7 to 21·7 in. Prony in his work on the Pontine Marshes shows that the depth evaporated per annum is 93 ins., and the rainfall only about one-third of this amount. At Nantes, observations give 71·2 for the evaporation, and 39·4 for the rain. At Marseilles, my own observations lead to an evaporation of 98·4.

The observations, however, made on the Canal de Bourgogne, at Saint Jean-de-Losne, Dijon, and Pouilly, under the direction of the Engineer-in-Chief, M. Delaporte, form a remarkable exception to the above rule. The annual results are given in the following table :—

YEARS.	Saint Jean-de-Losne. Altitude, 607 ft.		Dijon. Altitude, 790 ft.		Pouilly. Altitude, 1312 ft.	
	Rain.	Evaporation	Rain.	Evaporation.	Rain.	Evaporation.
1839...	35·6	23·7	33·0	27·3	32·3	22·8
1840...	36·7	28·8	32·7	30·2	26·0	23·3
1841...	38·2	22·8	35·2	19·9	37·1	18·1
1842...	26·9	27·6	20·3	28·5	23·3	27·7
1843...	35·8	15·7	28·3	22·6	35·3	22·2
1844...	28·4	23·2	26·9	26·4	29·2	22·3
1845...	34·8	14·0	30·5	18·1	37·4	19·1
Total ..	236·4	155·8	206·9	173·0	221·6	155·5
Mean ..	33·8	22·3	29·6	24·7	31·7	22·2

It will be seen from this table that only once in the seven years the evaporation exceeded the rainfall, viz., in 1842, which was the year of minimum rainfall, and that the average amount of evaporation is less than half what it has hitherto been generally considered to be.

I was so astonished at this result that I thought it must be attributed to faults of the instruments used or of observation, or to the evaporator being situated in the shade, but after most careful enquiries on all these points, I find that the observations are in every way perfectly unexceptionable, and to be relied upon. They are also confirmed by the following observations at La Roche-sur-Yonne, at an altitude of 279 feet :—

Year.	Rain. in.	Evaporation. in.
1841	16·8	14·8
1842	14·5	20·6
1843	20·3	19·7
1844	28·9	21·3
1845	26·0	20·0
Totals	106·5	96·4
Means... ..	23·1	19·3

We must, therefore, conclude that there is a district in France where the amount of evaporation is less than half what it is generally considered to be in our country, and we have no need to say what an important bearing such a result must have on the hydraulic works in that district. Is the line of the Canal de Bourgogne the only locality which is in this position?

We do not understand how in a country like ours, and with reference to one of the most important of hydraulic data, we can rest content with only knowing that the numerical value to be attributed to this datum, so essential for a large number of engineering works, lies within two limits, one of which is double the other.

Note sur la mesure de l'évaporation à La Roche-sur-Yonne pendant les années 1846 *à* 1850. Par M. Tarbé, Ingénieur des ponts et chaussées. (Annales, 3e série, Tom 3, p. 249.) 1852.

In a previous memoir, M. Vallès called attention to the measurement of evaporation in the district traversed by the Canal de Bourgogne, and showed from a summary of experiments at Saint Jean-de-Losne, Dijon, Pouilly, and La Roche, that the depth annually evaporated differs but little from the rainfall, whereas all authorities attribute double this value to it. The experiments made at La Roche during the five years, 1846 to 1850, given below confirm the results arrived at by M. Vallès.

Months.	1846.		1847.		1848.		1849.		1850.		Totals.	
	Rain.	Evap.	Rain.	Evap	Rain.	Evap.	Rain.	Evap.	Rain.	Evap.	Rain.	Evap.
Jan. ...	2·52	1·89	1·89	·43	1·30	·20	3·39	·20	3·27	·83	12·37	3·55
Feb. ...	·43	·51	2·01	·79	2·52	·75	1·02	·83	2·32	1·81	8·30	4·69
March	2·71	1·22	·47	1·61	2·91	·63	·59	1·02	·83	1·34	7·51	5·82
April..	2·99	1·85	3·15	·98	4·69	1·02	1·89	1·22	2·40	2·17	15·12	7·24
May ...	·63	3·31	1·06	2·80	·47	4·76	3·11	2·60	2·17	2·48	7·44	15·95
June..	2·16	4·60	2·01	3·54	4·02	3·34	1·89	4·02	2·05	4·21	12·13	19·71
July ...	·51	4·09	2·01	2·60	1·53	4·65	3·86	5·16	1·61	3·86	9·52	20·36
Aug....	2·79	2·91	·83	2·91	2·48	4·17	·51	3·58	2·60	2·56	9·21	16·13
Sept...	1·26	2·60	1·26	3·34	2·09	2·01	1·97	2·20	·75	2·44	7·33	12·59
Oct. ...	3·98	·35	1·89	·71	1·22	1·85	2·72	·87	1·73	1·10	11·54	4·88
Nov ...	1·46	·04	·98	·28	1·42	·31	2·68	·59	1·54	·59	8·08	1·81
Dec. ...	1·06	·28	1·38	·59	2·20	2·44	1·53	·51	1·22	·43	7·39	4·25
Total .	22·50	23·65	18·94	20·58	26·85	26·13	25·16	22·80	22·49	23·82	115·94	116·98

The place of observation is situated on a large plain, formed by the meeting of the valleys of the Yonne and the Armançon, at 279 ft. above the level of the sea, and the evaporation is measured in an uncovered basin, exposed on all sides to the action of the sun and the

wind. This evaporating basin, and the rain gauge annexed to it, were constructed after a model supplied by the Engineer-in-Chief, M. Bonnetat, as were also those at Montbard, Dijon, Pouilly, and Saint Jean-de-Losne.

The evaporating basin is 8 ft. 2½ in. square, by 1 ft 4 in. deep; it is constructed of masonry, and cased inside with sheets of zinc, a graduated scale is fixed on one of its inside faces, and on the first day of each month the water is filled up to a constant level—10 ins. for instance.

The rain gauge has a square funnel 3 ft. 3 ins. on each side, communicating by means of a valve, with the receptacle of one-fourth the area, with a glass plate let into one of the sides; behind the glass there is a scale on which the depth of rain is read off. The receptacle is surrounded with charcoal.

Note sur l'Évaporation. Par M. RUINET, Ingénieur ordinaire des ponts et chausées. (Annales, 3e Série, Tom 20, p. 150.) 1860.

In a note published in the Annales in 1850, M. Vallès called attention to the anomaly presented by the evaporation in the district traversed by the Canal de Bourgogne.

The observations made at Dijon, from 1845 to 1852 given below, show that the same anomaly continues

Years.	Rain. in.	Evaporation. in.
1846.....	29·7	..... 26·6
1847.....	27·0	..... 26·4
1848.....	26·6	..... 25·1
1849.....	23·3	..... 26·3
1850	25·1	..... 32·0
1851.....	24·4	..... 20·7
1852.....	32·0	..... 25·6
Total	188·1	182·7
Annual Means,	26·9	26·1

The assumption of errors in the observations is inadmissible. Must we, therefore, conclude, as M. Vallès seems disposed to do, that in laying out this navigable route the engineers had the good fortune to meet with a line of minimum evaporation? I think not, but that the apparent anomaly is due to difference in the instruments by which the evaporation is observed. The smaller the vessel used the greater the tendency of the water to heat unduly, and thus to cause an increase in the evaporation observed.

On the Canal de Bourgogne, the observations are made in basins of

at least 6 ft. 6 in. on each side. Few observers, probably, have such basins at their disposal, and this it is that explains the high figures which they have obtained. In 1850, being attached to the service of the Canal de Bourgogne, I had a small basin, only 11·8 in. square, made by the side of the great basin of 6 ft. 6 in. square. The two basins were in action together, from the 1st of May; during the whole month they were observed simultaneously every three days.

	in.
On the 31st the large basin showed an evaporation of.....	3·47
,, small basin ,, ,, ...	5·28
Difference	1·81

These comparative observations were continued, and gave for the whole year 1851 the following results:—

	in.
Rainfall	24·4
Evaporation, large basin.....	20·7
,, small ,, ...	29·1

I think, therefore, I am able to lay down that it is only necessary to choose similar instruments, in order to render the Canal de Bourgogne no longer an exception. The experiments made there must lead to the conclusion, that the evaporation which really takes place on the surface of a large natural extent of water, is far from being so great as the observations on a small scale would lead one to suppose.

Mr. Greaves, M.I.C.E., Engineer-in-Chief to the East London Water Works, has been for some years past making observations on the evaporation both from water and ground. The following table shews the results of his observations on the evaporation from water, partly taken from his evidence before the Rivers Commission, (*Second Report of Rivers Commission*, Vol. II., p. 22,) and partly from information kindly supplied by himself.

Rain and Evaporation Gauges kept by Mr. Greaves at Lea Bridge.

Date.	1860		1861		1862	
	Rain.	Evap.	Rain.	Evap.	Rain.	Evap.
	in.	in.	in.	in.	in	in.
March	5·227	1·227	6·932	4·932	6·645	1·895
June	10·520	8·645	4·141	8·766	7·813	7·064
September	9·312	8·187	5·374	9·749	5·332	6·457
December	7·499	2·998	7·852	3·727	6·791	1·916
Total	32·558	21·057	24·299	27·174	26·581	17·332

Date.	1863		1864		1865	
	Rain.	Evap.	Rain.	Evap.	Rain.	Evap.
	in.	in.	in.	in.	in.	in.
March	4·062	2·062	4·728	1·228	7·145	1·770
June	5·270	7·520	3·770	8·016	5·083	8·208
September	5·206	7·331	3·936	8·186	7·896	8·646
December	5·228	1·354	3·457	1·206	9·124	1·499
Total	19·766	18·267	15·891	18·636	29·248	20·123

Date.	1866.		1867.		1868.		1869.		Average, 1860 to 1869.	
	Rain.	Evap.	Rain.	Evap.	Rain.	Evap.	Rain.	Evap.	Rain.	Evap.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
March	9·291	1·666	8·333	3·958	6·436	5·186	7·000	2·750	6·580	2·667
June..	7·895	7·270	5·749	7·749	3·662	9·787	5·395	7·145	5·930	8·017
Sept..	7·855	7·980	8·729	6·604	4·166	9·291	4·354	6·729	6·216	7·916
Dec...	6·655	1·905	4·623	1·749	9·040	4·665	7·812	2·437	6·808	2·346
Total	31·696	18·821	27·434	20·060	23·304	28·929	24·561	19·061	25·534	20·946

Mr. Greaves' evaporation gauge consists of a light slate cistern, 12 ins. deep, and 36 ins. square inside, set afloat on a mill-stream, by means of a raft of timber. The cistern is immersed in the water, 3 or 4 ins. at the outside, and it is kept with about 4 to 6 ins. of water in it. This gauge is read once a month, by means of a dipstick in the centre of the cistern, and is never emptied. The mill-stream on which the cistern is floated is about 30 ft. wide, and the raft with the cistern on it is kept in the middle of the stream by means of ropes, and pulled to shore when the readings are taken. ROGERS FIELD.

BEVERLEY'S EVAPORATOR.

IT seems impracticable to measure, with any degree of accuracy, the evaporation from *the soil*, because the evaporation will vary according to the varying condition and composition of the soil. Thus the amount of evaporation from a sandy, porous soil will greatly differ from that from a stiff clay soil. Hence, I am inclined to think, that the only measure of the capacity of the atmosphere for taking up vapour that can have any claim to accuracy, is the measure of the evaporation from a still body of water of limited extent. Still,—because the evaporation from water in motion varies according to the rapidity of the movement. Limited,—because a large surface being more liable to be disturbed by the winds, the evaporation would necessarily be increased thereby. Evaporation, measured in this way,

would bear a certain relation to the results deduced from the hygrometer. But however limited the surface may be, it will still be affected in some degree by the wind. Hence the water in the evaporator must be protected by the walls of the evaporating vessel, to such an extent as shall not prevent the evaporation from going on with perfect freedom.

I began experimenting in connection with evaporation in 1868. For an evaporator I use my snow gauge, which is a zinc cylinder 10 ins. in diameter (as accurately made as possible), and 12 ins. in depth. At 9 a.m. on the 1st of the month, I measured with a graduated glass measure for a 10 in. rain gauge, 3 ins. of water into the gauge. The gauge was then put in an open space, where it might receive the rain freely, and where evaporation could go on without hindrance. At 9 a.m. of the 1st of the following month, I measured the water that was at that time in the gauge, and subtracted the amount from 3 ins., *plus* the rainfall as measured by the ordinary rain gauge. Thus, on 1st August, 1868, I put 3 in. into the gauge, and on 1st September I found the amount in the gauge to be 7·370 in. The calculation then stood thus :—

On 1st August, put into evaporator	3·000 ins.
Add rainfall for August..... ..	6·938 ,,
	9·938 ,,
Subtract amount in gauge on 1st September...	7·370 ,,
Evaporation for August.....	2·568 ,,

I soon perceived that the evaporation varied a little according to the distance of the surface of the water from the mouth of the gauge, the distance being often 11 ins., on other occasions much less, on one, little more than 5 ins. Hence I thought that it would be of advantage if I could contrive to keep the water as nearly as possible at a uniform level. With this object in view, in the end of 1868, I got a vessel made, which is roughly represented in the figure. A, B, C, D, is a zinc cylinder, 12 ins. deep and 5¼ ins. (inside) diameter at the mouth, though a little wider below. E is another zinc cylinder, 6 ins. deep, and 5 ins. (exact) diameter (inside), fitting pretty closely into A, B, C, D at the mouth, but rather less closely below; *h* is a hole in the side of E, 1¼ in. from its upper edge, and ⅛ in. in diameter. F is a flange on the upper edge of E, overlapping the upper edge of A, B, C, D, to keep out rain. *e* and *s* are, respectively, the water in the evaporator E, and the surplus water in the reservoir, R, overflowing from E by the hole *h* (or H, to be afterwards explained).

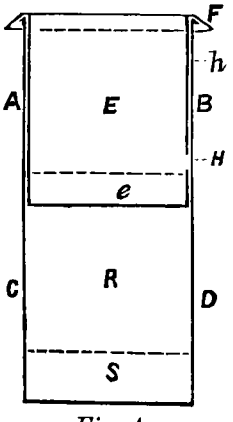


Fig. 4.

On the 1st of the month I put, say, 5 ins. of water into E; the water of course rose above *h* and overflowed into the reservoir R. Also, whatever rain fell, if it was more than sufficient to raise the level of *e* to *h*, overflowed into R. If the water in E fell at any time rather low, I poured in water from R to bring it up to *h* again. Thus, by a little watching, I was able to keep the level pretty uniform. If at any time, as in July last year, the water in R was insufficient to raise the level in E to *h*, I added an inch or two, according to circumstances, and took account of it on the 1st of next month. When I came to measure the evaporation, the calculation was effected as in the case already given.

I continued observations by the evaporator as thus arranged during 11 months, but began to suspect that *h* was too near the mouth for two reasons:—First, when a heavy shower of rain fell, the water would be "splashed" out of E, and thus the evaporation would *seem* to be greater than it actually was. Second, the wind disturbed the surface at *h* too much, and would thus increase the evaporation. Hence I thought it would be necessary to lower the level. The intense frosts in the beginning of December last decided me. The large body of water in E got frozen into a solid mass, and the bottom of the inner cylinder was three times torn out. I then got the hole H made, 1½ in., from the bottom of E. This lowers the level of *e* 3 ins., and (almost) prevents outsplashing, and greatly reduces the effect of the wind. Recent frosts also prove, that when the smaller body of water is frozen, there is much less danger that the evaporator will be burst. The greater depth of the surface level also allows snow, when it falls into the receiver, to be retained, unless it is of unusual depth.

At present I put in only 2 ins. on the 1st of the month, but as the summer comes on, it will be necessary to put in 4 or 5. It is better to put in a definite measure than merely to fill up to the hole H, then fill up to that point on the day of measurement, and not take *e* into account at all, because *e* will vary according as E is kept level or not, when the measurement is made. If a definite quantity is poured in when the gauge is in position, then, in measuring, the total contents of E and R must be measured.

From the small quantity of water in the evaporator, it now requires more constant watching, to guard against the level of *e* becoming too low, but as the evaporator is placed side by side with my rain gauge, this involves no additional labour.

On the whole, I am well pleased with the form my evaporator has ultimately taken. The flange is perhaps rather broad and flat, and

may cause a little insplashing, but it cannot be much, in ordinary cases, and, I believe, will be fairly counterbalanced by outsplashing. It may be made a little narrower and steeper, but it must be made strong enough to keep E perfectly circular, and broad enough to overlap the upper edge of A, B, C, D, to prevent the ingress of rain in an irregular manner into R. But whatever form may be given to the flange, its upper edge must be truly turned to 5 in, so that the receiving space for rain may correspond with the evaporating surface below.

This evaporator is simple in form and easily managed; no intricate calculations are required, and no measure is necessary but that used for the ordinary 5 in. rain gauge. It is, I believe, tolerably accurate, and more care in the construction would of course make it still more accurate. But I have no prepossession in its favour; I am willing to adopt whatever form may be ultimately decided upon. But it is absolutely necessary that there should be uniformity in the construction of instruments, and uniformity in the plan of using them, in order that observations in different places may be comparable. If uniformity of this sort was once established, I believe the results would show as much uniformity over the country in the case of the evaporation, as in the case of any other meteorological phenomenon. At present there is the greatest confusion in the results obtained.

BUIST'S EVAPORATOR.

Dr. Buist, of Bombay, was one of the most able of modern meteorologists, and he devoted considerable attention to the question of evaporation, but though clearly perceiving the importance of the subject, and the imperfection of all ordinary instruments, his untimely death prevented his having suggested any improvements, for the arrangement shown in fig. 5, can hardly be deemed as such; it is simply a rain gauge funnel, plugged at the bottom, into which a known quantity of water is poured, and the plug being withdrawn, subsequent measurement shows the total loss during the interval.

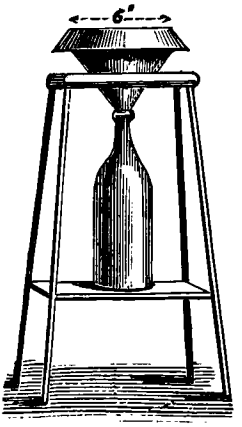


Fig. 5.

Some of Dr. Buist's remarks are, however, sufficiently suggestive to merit their transference from his valuable *Manual of Physical Research for India.*

"One of the first facts on this point to be determined, mixed up as it is with the hygrometer, is, not how much water the air contains, but how much it carries away; and unhappily our means of ascertaining the exact amount of evaporation from any given surface under any assumed class of circumstances, such as the

temperature, the moistness, and the velocity of the wind, are in the last degree imperfect and unsatisfactory. Evaporation is not only dependent on the various conditions of the air just referred to, but on a variety of peculiarities of the surface, from which it arises. It differs in degree over every variety of country, or variable surface, according to its hue, texture, temperature, and humidity; and the confusion arising from this is so extremely great, that very rude approximations indeed must for the present content us. But not only does the condition of the surface of the earth present us with endless varieties of adaptations for evaporation, the surface of water under different circumstances is affected in many different ways by the impact of moving masses of air. The great body of the ocean, or of the waters of deep lakes, afford a considerable degree of uniformity as to temperature; but when raised in waves or spray, or agitated by the winds, the evaporating surface presented by them is infinitely greater than when they are at rest; and it is, besides, in a condition much more open to be acted on by an evaporating agent. Estuaries, bays, rivers, and still shallow pools, again, are apt to get warmed by the influence of the sun much beyond the temperature of the adjoining waters—as, on the other hand, they get cooled beneath them by the radiation of a clear sky. To meet these various conditions of things, the most simple and serviceable contrivance we possess is the evaporating dish, an instrument for which, like the rain gauge, we have no equivalent, which instead of being made the most of until something better can be found, has been treated with almost total disregard, so that, poor as it is naturally, its natural poverty has been aggravated by neglect."

"In India, the evaporating dish ought never to be exposed to the sun, unless the difference of evaporation at different temperatures with the same breeze is meant to be ascertained. The water in an evaporating dish in the sun will often rise to a temperature of 120°, while that of the atmosphere around is no higher than 80°; this only occurs with small masses of water—so as to have nothing analogous to it amongst the phenomena of nature desired to be investigated; the surface of the ocean seldom differing more than a few degrees from the air around—the mean temperature of the two approximating closely to each other. A shaded dish, fully exposed to the breeze, though not correct in its indications, will be found infinitely more so than one exposed to the sun.

"Actual weighing of the evaporating dish, contents and all, is the most accurate method of determining evaporation, but it is so troublesome and tedious that it is not likely often to be made use of. Where the evaporation from damp earth or other similar surface is to be determined on, the weighing must on almost all occasions be resorted to. I have found a steel-yard of the following fashion to

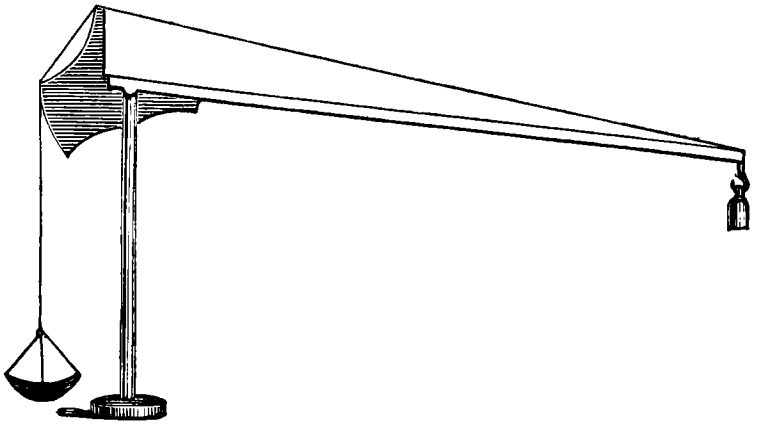


Fig. 6.

afford very interesting results for short periods of time, say at the change from the land to the sea breeze. It is made up of straight pieces of deal wood, tied with a thread to keep it stiff. As the water evaporates, the dish, suspended from the shorter end of the lever, becomes lighter, and the larger descends—the amount of its descent, which indicates the amount of evaporation, being read off by a graduated scale. The whole, with the exception of the dish, must be under glass, to escape the disturbances occasioned by the wind."

CASELLA'S EVAPORATOR.

Two forms of evaporator are sold by Mr. Casella; one is fig. 1, p. 154, except that the small central pipe is carried up through the centre of the water to within 1½ inches of the top of the vessel, and its upper end left open; it thus forms an overflow pipe to carry an excess of rain into the bottle below. The other is simply a 5-inch cylinder like fig. 2, p 154, but intended to stand on the ground, instead of being sunk in it. In both these forms the whole of the contents have to be measured in a divided glass every time an observation is made.

DALTON DR. JOHN—(*see* WATSON.)

DINES, G. Esq., PYPORTS, COBHAM.

Although no results have yet been published by this observer, we are aware that he has accumulated a considerable store of facts, and is gradually working them into shape. One of his contrivances for delicate measurement is so very ingenious, that we annex an engraving of it.

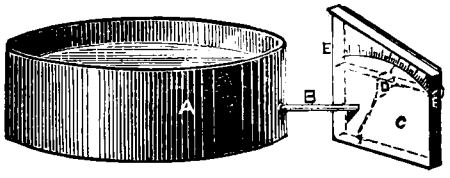


Fig. 7.

The vessel A, 18 ins. diameter, is buried in earth, in the stump of an old elm, about 4 ft. above the ground; it is connected by the pipe B with the small covered vessel C. As the water evaporates from A, the hinged float D falls over, and is read off on the divided arc E E′. A max. and min. ther. is placed under the surface of the water.

From this he finds that the vessel is too small, as the water in it varies much more in temperature than does the river Mole, which is close by, and hence, he concludes that the only true way to ascertain the amount of evaporation is by an evaporator fixed in the midst of a large piece of water.

Mr. Dines has been observing the influence on the amount of evaporation produced by the angular elevation of the sides of the vessel above the water; he finds it considerable, but variable.

EATON, H. S. Esq., M.A.

The evaporation observations at Little Bridy, Dorset, were taken on the last day of the month, from a circular evaporating dish of copper, 8 ins. in diameter, and $5\frac{1}{2}$ ins. deep; the diameter of the rain gauge being precisely similar, the same measure was used for each. The dish was fully exposed to the sun on an open lawn, close to the rain gauge, the upper edge of both being 4 ins. above the surface; thus the evaporating dish was sunk $1\frac{1}{2}$ in. into the ground. At the commencement of the observations 1 in. in depth of water was put into the dish, and the water was kept as nearly as possible at that level, by adding or deducting as was found necessary. The measurements were taken by emptying the dish. It may be remarked, that occasionally the temperatura of the water was between 90° and 100° in July, 1859. The observations came to an untimely end by the bursting of the dish from frost in January, 1861.

FLETCHER, ISAAC, Esq., M.P., F.R.S.—(*see ante* pages 38, 39).

GLAISHER, J., Esq., F.R.S., &c.

[Extract from an early edition of Glaisher's Hygrometrical Tables. In later editions this paragraph does not appear.]

"Evaporation is the conversion of liquids into elastic fluids by the influence of heat; expose, for instance, water to that influence; bubbles at first appear, which by degrees ascend to the surface and burst. These bubbles rise the more rapidly in proportion to the heat.

"Water evaporates in the open air at very low temperatures, and the vapour rising into the air mixes with it in an invisible form, until it is condensed, and assumes that of clouds, fog, mist, or falls in the shape of rain.

"The amount of water thus changed into vapour is very large indeed. From experiments I have made during the years 1844, 1845, and 1847, it appears to be nearly 50 inches annually. It is probable that this quantity is much above the average; but all experiments that I have seen justify us in assuming that the average evaporation is more than 30 inches annually (that is, that the vapour in the atmosphere in one year, if reconverted into water, would cover the surface from which the evaporation took place to a height of 30 inches). Assuming that this is about the annual quantity, and that the surface of all the waters on the earth is 130,000,000 of miles, then, water to the amount of 62,000 solid miles would be annually changed into vapour. To this large amount must be added the evaporation from moist earth, and from the watery parts of the animal and vegetable kingdoms.

"To all persons engaged in meteorological researches, the knowledge of the distribution of this mass of water with the air is necessary, as we may readily infer that the most important changes in our atmosphere are occasioned by it."

GREAVES, C. Esq., C.E.—(*see* p. 161).

HOWARD'S EVAPORATOR.

The following description is from the *Climate of London*, by LUKE HOWARD, F.R.S., 2nd edition, p. xix:—

Fig. 8.

"The graduated measure, for the Rain being numbered on the opposite side of the scale downward, serves also to ascertain the *Evaporation.* For this purpose, a cylindrical tinned copper vessel is employed, of five inches diameter within, furnished with a rim to prevent spilling, in which is a lip, set on clear of the cylinder. Two measures, or an inch, of water being poured in, fills two-thirds of the cylinder; the vessel is then placed near the ground, in a situation where it may be sheltered from rain, and have the sun's rays, without reflection. At the end of twenty-four hours, or a longer period, extending to a week if desirable, but regulated by the season of the year, the water being returned into the measure, the quantity which is evaporated may be read off, and the vessel replenished. For warmer climates, or longer periods of observation, the depth of the vessel may be increased, and a greater number of measures put in."

The author subsequently suggests the employment of a divided glass, placed diagonally, as a facile mode of measurement; we hardly need illustrate this plan it is so simple. Let A B be one inch, and A C ten

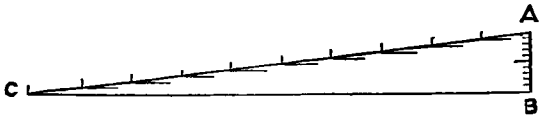


Fig. 9.

inches, then it is evident the water as reduced by evaporation, will cut the scale at points, travelling downwards, and at the same time towards C, *i.e.*, along A C, and if the scale be as above described, the linear distance travelled by the water line will be ten times greater than the actual depression, hence considerable delicacy of reading may apparently be expected. I find, however, that owing to the action of wind on the water surface, and the cohesion of the water to the scales, this mode of observation is not satisfactory.

With the apparatus above represented, and observed under cover as directed, Howard found the evaporation to be about 20 ins. per annum.

LESLIE'S ATMOMETER,

Is described in his treatise on *Heat and Moisture*, pp. 80 and 88, and as that work is scarce, and many of the remarks are very suggestive, and not confined to descriptions of his instrument, some rather lengthy extracts become necessary.

"The separate and distinct effects of evaporation, the coldness it occasions, and the quantity of moisture it abstracts, are obviously seen in the hygrometer, as contrasted with an instrument which I have lately formed to measure the quantity of exhalation from a humid surface in a given time, and which I therefore

call an *Atmometer.** (See fig, 10.) This instrument consists of a thin ball of porous earthenware, two or three inches in diameter, with a small neck, to which is firmly cemented a long and rather wide tube, bearing divisions, each of them corresponding to an internal annular section, equal to a film of liquid that would cover the outer surface of the ball to the thickness of the thousandth part of an inch. These divisions are ascertained by a simple calculation, and numbered downwards to the extent of 100 or 200 ; to the top of the tube is fitted a brass cap, having a collar of leather, and which, after the cavity has been filled with distilled or boiled water, is screwed tight. The outside of the ball being now wiped dry, the instrument is suspended out of doors, and exposed to the free action of the air.

"Evaporation is always proportioned to the extent of the humid surface. If a sheet of wet paper be applied to a plate of glass, it will, in a close room, lose its weight exactly at the same rate, whether it be held vertically or horizontally, and whether it occupies the upper or the under side of the plate. The quantity of evaporation from a wet ball is the same as from an equal plane surface, or from a circle having twice the diameter of the sphere. In the atmometer, the humidity transudes through the porous substance, just as fast as it evaporates from the external surface ; and this waste is measured by the corresponding descent of the water in the stem. At the same time, the tightness of the collar, taking off the pressure of the column of liquid, prevents it from oosing so profusely as to drop from the ball, an inconvenience which, in the case of very feeble evaporation, might otherwise take place. As the process goes on, a corresponding portion of air is likewise imbibed by the moisture on the outside, and being introduced into the ball, rises in a small stream, to occupy the space deserted by the subsiding of the water in the tube. The rate of evaporation is nowise affected by the quality of the porous ball, and continues exactly the same when the exhaling surface appears almost dry, as when it glistens with abundant moisture. The exterior watery film attracts moisture from the internal mass with a force inversely as its thickness, and will therefore accommodate the supply precisely to any given degree of expenditure. When this consumption is excessive, the water may be allowed to percolate, by unscrewing the cap, avoiding, however, the risk of letting it drop from the ball.

"In still air, the indications of the hygrometer and those of the atmometer, bear the same proportion, and the quantity of evaporation for every hour is expressed in thousandths of an inch in depth, by the twentieth part of the hygrometric degrees. For example, in this climate the medium dryness in winter being reckoned 15°, and in summer about 40°, the daily exhalation from a sheltered spot will amount in winter to a thickness of ·018, and in summer to ·048 decimal parts of an inch. If we reckon the mean daily evaporation from the ground while screened at ·030, the waste during the whole year will amount to near 11 inches, being scarcely the half perhaps of what, under the circulation of the atmosphere, actually obtains. The dissipation of moisture indeed is vastly accelerated by the action of sweeping winds, the effect being sometimes augmented five or ten times. In general, this augmentation is proportional, as in the case of cooling, to the swiftness of the wind, the action of still air itself being reckoned equal to that produced by a celerity of eight miles each hour. Hence the velocity of wind is easily computed, from a comparison of the indications of an hygrometer with an atmometer, or of a sheltered with those of an exposed atmometer. Thus, suppose the

* From ατμος, *exhalation* or *vapour*, and μετρον, *a measure.*

hygrometer to mark 40°, or the column in a sheltered atmometer to subside at the rate of two divisions each hour, while in one exposed to the current, the descent is twelve divisions ; then, as 2 is to 10, the superadded effect of the wind, so is 8 to 40 miles, its velocity during the hour."

"The atmometer is an instrument evidently of extensive application and of great utility in practice. To ascertain with accuracy and readiness the quantity of evaporation from any surface in a given time, is an important acquisition, not only in meteorology, but in agriculture and the various arts and manufactures. The rate of exhalation from the surface of the ground is scarcely of less consequence than the fall of rain, and a knowledge of it might often direct the farmer advantageously in his operations. On the rapid dispersion of moisture, depends the efficacy of drying houses, which are too frequently constructed most unskilfully, or on very mistaken principles. But the purposes to which the atmometer so aptly applies, were hitherto supplied in a rude and imperfect manner. The loss that water sustains in a given time from evaporation has commonly been estimated by weight or measure. If a piece of flannel stretched by a slender frame, be wetted and suspended in the free air, its dissipation of moisture, after a certain interval, is found by help of accurate scales ; or if water in a shallow pan be exposed in a similar situation, its daily waste is detected by the application of a finely divided rod or gauge. But these methods are extremely troublesome, and are subject besides, especially the latter one, to great inaccuracy. Both the flannel and the sheet of water require to be sheltered against the wind and rain, and consequently they will not exhibit, like the atmometer, the real exhalation which takes place from the ground. The bottom and sides of the pan must also, from their extent of dry surface, affect the temperature of the water, and consequently modify the quantity of evaporation."

"Fig. 10 represents the *Atmometer*, an instrument designed to measure the quantity of evaporation, by the descent or waste of a column of water. It consists of a ball of thin porous earthenware, to which is cemented a wide glass tube, bearing divisions which correspond each to the measure of a film of water that would cover the external surface to the thickness of the thousandth part of an inch. These balls are elegantly formed, by my direction, at the celebrated manufactory of Etruria in Staffordshire, and I have lately received some, only an inch in diameter, and of the most delicate execution."

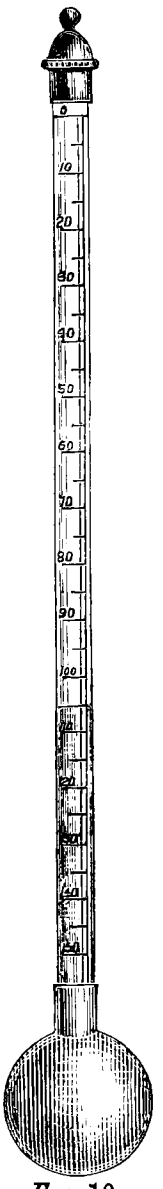


Fig. 10.

Another form of this is described in Dr. Buist's work from which we have already quoted, wherein the porous bulb is replaced by a cedar-wood plug in the end of a graduated glass tube.

MILLER, J. F. Esq., Ph. D., F.R.S., &c., Whitehaven,

Employed a dish, 8 ins. diameter, exposed by day to wind and sun

(but sheltered by surrounding walls), at night, and during rain, it was placed under a capacious shed, 9 ft. high, and open at the front. His mean for 12 years was 29·664.

MILLER, S. H., Esq., F.R.A.S., Observatory, Wisbech, Cambridgeshire,
Has two evaporators; No. I., a Negretti's evaporator placed on the ground, in a larger cylinder filled with sand, kept constantly wet. No. II., an 8 in. cylinder, 4 ins. deep, placed in a small wooden erection, constructed to allow a free current of air, and to exclude all rain and sunshine. The results of both these are given in the table at the end of these notes.

MILNER, W. R., Esq., The Prison, Wakefield.

I am not aware that any description of the instrument used by this gentleman is in existence. If I remember rightly, it was a zinc pan about 10 ins. square and 3 ins. deep, standing on a pedestal about 4 ft. above the ground, but as it is nearly ten years since I saw it, and then I only casually noticed it, my memory may have played me false.

MITCHELL'S EVAPOMETER.

A very elaborate evaporator, with half-a-dozen taps and three divided scales, has been designed by Dr. Arthur Mitchell, and is figured and fully explained in the *Quarterly Report of the Meteorological Society of Scotland*, for the quarter ending 30th September, 1860. Its special feature (and a very good one) is the adoption of a modification of the common bird fountain, whereby the water in the evaporating dish is kept at a constant level; the objection to it, in my opinion is, that the dish is of metal, shallow, and very much exposed to sunshine, so that the water will be raised to a temperature far above that of any lake, pond, or even ditch.

NEGRETTI'S EVAPORATOR

Is similar to Casella's, fig. 2, p. 154, except that it is of larger diameter and much shallower. The whole of its contents have to be measured on each occasion.

PHILLIPPS, MAJOR, R.E.—(*see* p. 156).

PROCTOR, Mr. J., Barry, N.B.

The evaporator used by this observer, and already referred to in p. 152, consists of a zinc box 10 ins. square, and 4 ins. deep, standing on a sort of dwarf stool. From 1854 to 1864, it was covered with a roof to keep out the rain; since that time it has been fully exposed. The widely different results are shown in the table.

SHARPLES, G., Esq., South Shore, Blackpool, Lancashire.

The rain and evaporation gauges are almost identical in form (float gauges), but the funnel of the evaporator is kept nearly full of water; they are placed side by side in a large tub of earth, partly sunk in the ground, so that their receiving surfaces are 1 ft. 8 ins. above it. The result of 14 years' observations are given in the table, page 176.

STEINMETZ'S VAPORIMETER,

Described and figured in his *Sunshine and Showers*, p. 142, is shown in fig. 11. It consists of another application of Luke Howard's inclined scale, or more properly perhaps, of that of the Diagonal Barometer. It is simply a 5-inch cylinder A, set upon a pedestal G, from one side of it at D, a graduated glass tube extends to E, and this tube is held in its position by the brass rod F. If the instrument be filled up to the level of the dotted line B, the water will stand in the inclined tube at B′, and if on the next observation the water-level has sunk to C, it will stand in the inclined tube at C′, and according to the inclination of the tube the space B′ C′ may be twice or twenty times that of B C, thus any required openness of scale may be obtained.

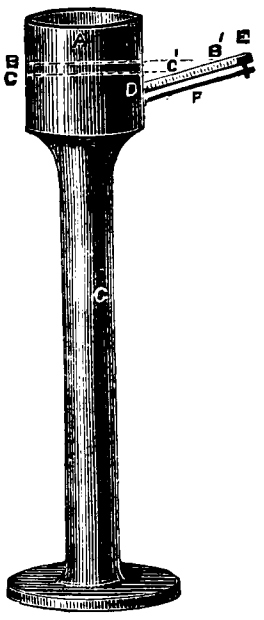


Fig. 11.

SYMONS, G. J. Esq.

I am responsible for a somewhat crude suggestion in *British Rainfall*, 1868, which is defective, because the distance from the edge of the vessel to the surface of the water is variable. In the experiments described on page 155, I kept the water at a nearly constant level, but I am doubtful of the accuracy of the plan. At any rate, Mr. Griffith has it on trial.

WATSON, H. H., Esq., F.C.S.

To the Editor of British Rainfall.

Sir,—In reply to your note of 1st inst., I have to say that I was a pupil to the late Dr. John Dalton, of Manchester, and it was at his request that I first began to keep rain and evaporation gauges at Bolton, and his request also was, that my gauges should be of the same size as his (10 ins. in diameter), and exactly like his, so that he could compare my results at Bolton, with his at Manchester. I have

continued to have the same sort and size of gauges hitherto. You will find my observations for the ten years, from 1831 to 1840, in a paper by Dr. Dalton, in the *Manchester Philosophical Society's Memoirs*, Vol. VI. new series, along with his rain, &c., tables. He only occasionally had an evaporation gauge at work, and for some years before he died, he had no evaporation gauge. He particularly recommended the form of gauge which I use, as being the best and most convenient of any of the rest which he had tried—there being the least trouble attending it, and for this reason he desired that I would adopt it. The rain gauge is a funnel of 10 ins. in diameter, which delivers the rain into a closed vessel—a bottle or the like. The contents of the receiving vessel (the rain caught therein) are occasionally measured in cubic ins., by pouring it into a graduated glass vessel, and the *depth* of rain is found by dividing the number of cubic ins. by the area of the funnel (78·54).

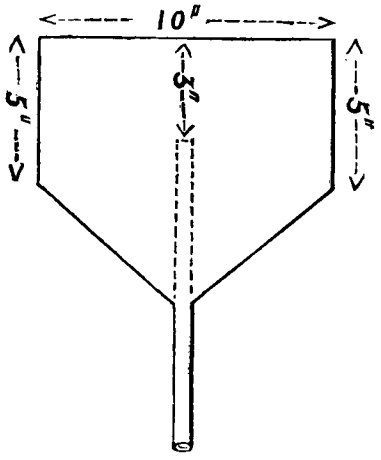


Fig. 12.

By this sketch, *without* the dotted lines, you will perceive the copper funnel, used as the *rain* gauge funnel. And, by the same sketch, *with* the dotted line, you will perceive the other copper funnel, used as the evaporation gauge funnel. The tube in each funnel is half-an-inch in diameter. In the evaporation funnel, the tube extends up into the inside of the funnel (as shown by the dotted line) to 3 ins. from the top.

The rain funnel and the evaporation funnel are placed (a foot from each other) on a wood frame, under which the bottles or receivers for the water are placed. The top of each funnel is 3 ft. 6 ins. above the ground. In setting the gauges, the rain funnel is so placed, merely that the rain falling into it will pass direct into the receiver or bottle;

but the *evaporation funnel* is filled up with water to the TOP of the ½ in. tube (top of the dotted lines); and then, supposing there to be a few dry days before any rain falls, afterwards, when rain does fall, no water (as you will perceive) can pass into the receiver or bottle, till the evaporation funnel has become filled up with rain to the top of the ½ in. tube, rain now supplying the loss by evaporation during the dry days. In going to measure the water in the two receivers, we find a less number of cubic ins. of water in the receiver of the evaporation gauge than in the receiver of the rain gauge, and the difference between the two quantities is that lost by evaporation; and this difference, divided by the area 78·54, shows the depth. If, on going to measure the water, the evaporation funnel is found not full to the top of the tube, water from the receiver belonging to it is poured into the funnel till this be full to the top of the tube, or, if there be not enough of water in the evaporation gauge receiver to so fill up the tube, *other* water (measured in cubic inches) is used to fill up the funnel, and the quantity of additional water thus required, is added to the difference to be divided by the area of the funnel.

The evaporation gauge stands along with the rain gauge in the open air, exposed to rain and storm. I don't think wind blows water often, if at all, over the outside or rim of the evaporation funnel, though it does sometimes blow some of the water from the funnel over the top of the tube into the receiver, which is not particularly objectionable.

You see there will be about 2 ins. in depth of water from the top of the tube to the point A, and below the point A (the 10 in. area) the evaporation is not allowed to go, to prevent which, a measured quantity of water is sometimes put into the funnel.

I have but roughly and in a hurry written this description, but I hope you will understand it.

I remain, dear Sir, yours most respectfully,

HENRY HOUGH WATSON.

The Folds, Bolton-le-Moors, Feb. 3rd, 1870.

Annual Amount of Evaporation, according to various Observers.

Year.	Rev. A. Beverley, Skene Street, Aberdeen.	H. S. Eaton, Esq., M.A., Little Bridy, Dorset.	I. Fletcher, Esq., M.P., F.R.S. Tarn Bank, Carlisle.	Rev. C. H. Griffith, F.M.S., Strathfield Turgiss.	S. H. Miller, Esq., F.R.A.S., Observatory, Wisbech.		W. R. Milner, Esq., Wakefield.	Mr. J. Proctor, Barry, Forfar, N.B.		G. Sharples, Esq., South Shore, Blackpool.	H. H. Watson, Esq., F.C.S., Bolton-le-Moors.
					No. 1, exposed	No. 2, covered		Cover'd	Expos'd		
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1856	...	...	...	...	...	...	27·95	11·43	. .	29·55	20·03
1857	...	...	...	...	...	...	28·72	15·17	...	28·98	22·52
1858	...	25·86	...	...	...	...	28·81	22·61	...	30·27	22·21
1859	...	29·04	...	...	..	...	32·53	15·24	...	30·58	18·99
1860	...	22·85	...	...	...	...	26·66	10·11	...	26 65	21·94
1861	...	...	...	...	...	...	...	11·95	...	28·45	19·45
1862	...	...	...	...	17·54	...	31·83	11·81	...	24·60	17.80
1863	...	...	..	...	22·47	...	36·72	14·65	...	25·27	19·0[illegible]
1864	...	...	44·23	...	21·97	12·63	31·09	11·09	...	32·35	20·31
1865	...	...	48·03	...	23·40	10·76	33·22	...	28·65	29·42	20·24
1866	...	...	49·55	...	18·55	9·17	...	...	29·79	30·86	19·03
1867	...	...	46·34	...	...	...	..	...	36·65	29·35	18·88
1868	...	...	50·42	39·74	24·14	12·06	...	...	37·85	35·03	23·41
1869	48·05	...	46·74	40·81	19·33	9·35	...	...	37·95	31·74	19·24
	48·05	25·92	47·55	40·28	21·06	10·79	30·84	13·78	33·98	29·51	20·22

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